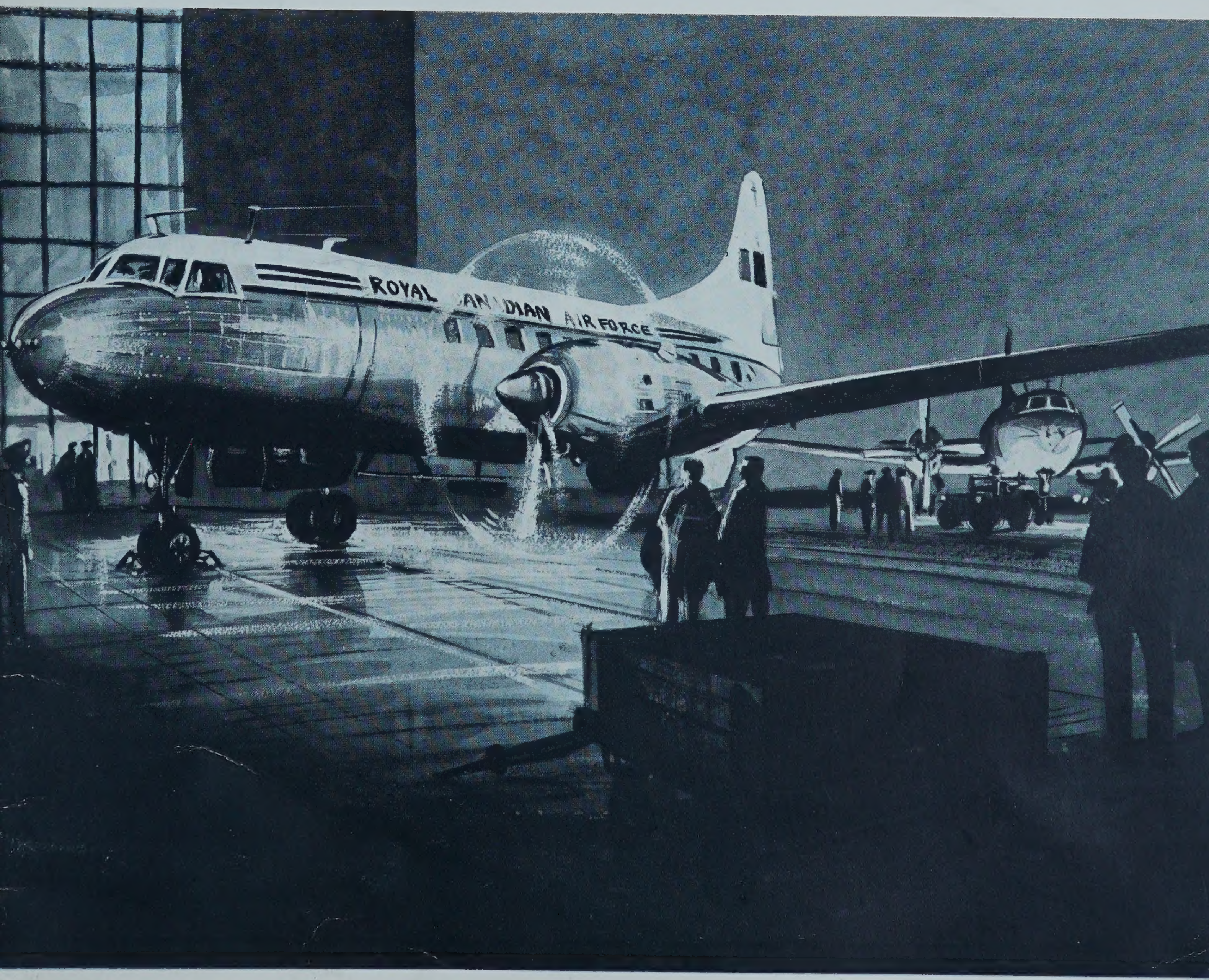
J. Hornick

THIS IS NAPIER



THE MAGAZINE OF D. NAPIER & SON LIMITED VOL 1 · NO 3 · 1958

THIS IS NAPIER

CONTENTS

THIS IS NAPIER is published by D. Napier & Son, Limited, London, W.3, England. Printed by Williams, Lea and Company Limited, London, E.C.2.

COMMENT

This year Napier complete 150 years of business life in a highly competitive industry, and the occasion is being marked by an exhibition in London, and in other ways.

Over the past century-and-a-half Napier factories and workshops have produced a range of machines and equipment so wide and varied that it almost defies listing. In many of its ventures the company has played the role of pioneer; in others, its part has been that of the improver.

In the 1820s the Napier touch doubled the rate of printing and raised the quality of printed work. A Napier machine made bullets more accurately and faster than they had been made by earlier methods. Machines produced by Napier replaced manual methods in the weighing of gold coins and the blanks from which gold coins were made, and proved to be faster and more accurate.

The company tackled heavy machinery as well as light, and built overhead cranes for arsenals and railways, and similar weighty items. Time was also found for the production of a formidable list of single items, such as a peat compressor for an Irish landlord, a tide gauge for the Admiralty, calculating machines, innumerable prototype machines, items for astronomers' telescopes, and a machine which, by centrifugal force, separated molasses from sugar. The company even took on the repair of ships.

The end of the nineteenth century saw the birth of the motor-car. In its development Napier played the role of pioneer, winning a place of prominence and distinction. World War I diverted the company from motor-cars to aero engines—and to a place of eminence in yet another industry. For nearly thirty years aero engines remained the company's main pre-occupation.

Here, again, it played a pioneering role, bringing to a state of operational perfection the " H " type engine which led, by stages, to the design and production of the 4,000 b.h.p. Sabre that represented the ultimate in piston aero engine development. Today, the company has recaptured some of its early character and spread its activities over a wide range of engineering commodities.

The thread that links the Napier of today with the Napier of the past, though as fine as gossamer and as brittle as porcelain, is strong enough to support pleasant recollections of achievements in another age. It would be a fatal thread, however, if the triumphs of other years led Napier of today to grow complacent.

The risk is small. In this year of celebration the company is, for the first time, making four different types of engine—the Eland propeller turbine, the Gazelle free turbine, the Deltic diesel, and the Double Scorpion rocket engine—as well as turbo-blowers for diesel engines, the " Spraymat " heating system, precision castings and experimental ram-jets.

The prosperity of the company was built and sustained by three generations of Napier, the last of whom died twenty-seven years ago. Today's historian finds a striking parallel between the engineering skill, versatility and foresight of David Napier, the founder, and that of those upon whom his mantle now falls.

OUR COVER PICTURE

The Canadian Government has ordered a fleet of Canadair 540 transports—Eland-engined Convair 440 airframes—for service with the Air Transport Command of the Royal Canadian Air Force. This airfield scene shows a Canadair 540 wearing R.C.A.F. markings

OPPOSITE: Twenty-two English Electric DELTIC diesel/electric locomotives, each powered by two 1,650 h.p. Napier Deltic high speed engines, have been ordered by the British Transport Commission for operation on the Eastern Region of British Railways. This picture shows the prototype DELTIC hauling a B.R. Midland Region long-distance passenger train

A Deltic alternator set

The Chelmsford (Essex) works of Marconi's Wireless Telegraph Co Ltd. have been the proving ground for a Deltic alternator set consisting of an 18-cylinder diesel engine and a lightweight alternator designed and built by the English Electric Co. Ltd. As the result of experience gained with the prototype, another set has been sold to an overseas customer

FOR NEARLY A YEAR, a Deltic alternator set has been running an average of 10 hours a day at the Chelmsford (Essex) works of Marconi's Wireless Telegraph Co., supplying about half the power required to meet the needs of the works. The results obtained have confirmed Napier's claims that the Deltic, driving a lightweight alternator, can provide the lightest and most compact set for its output in the world.

Power from the set, which has a 12-hour rating of 1,200 kW. at 0.85 power factor, generating at 3,700 volts, three-phase 50 cycles, is fed into any or all of three sub-stations through a seven-panel, metal-clad switchboard.

Engine controls—a Start and a Stop button, and a lever for increasing and decreasing the engine speed—are carried on a panel mounted on the engine and duplicated on another panel outside the engine room. An engine speed indicator is duplicated in the same manner. Automatic aural and visual warning devices come into operation if a running fault develops; if the warning is ignored, and the fault persists, the engine shuts itself down.

Starting is by means of compressed air stored at a pressure of 450 lb./sq. in. in two 7 cu. ft. capacity bottles, which are kept charged by an electrically-driven " Broomwade " compressor. The starting sequence is automatic and, after starting, the engine idles at 700 r.p.m. Its normal operating speed is 1,500 crankshaft r.p.m., corresponding to an engine rating of 1,725 h.p.

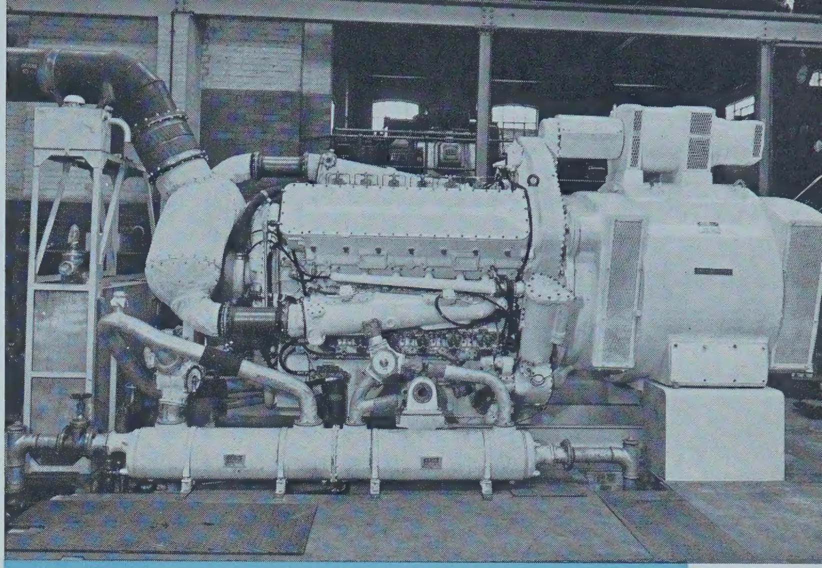
Besides being the lightest for its power in the world, the Deltic alternator set is extremely compact. It is only 15 ft. long, 6 ft. wide and 8 ft. high. The alternator is flange-mounted to the engine, a gear-tooth coupling being used to allow for any slight misalignment which might occur.

The set and most of the auxiliary equipment are enclosed within a sound-proof booth 28 ft. long, 8 ft. wide and 10 ft. high, and a specially designed " Maxim " silencer is fitted to the engine exhaust. No complaint about noise from the set has been made by people living in houses not 20 yards from the power house.

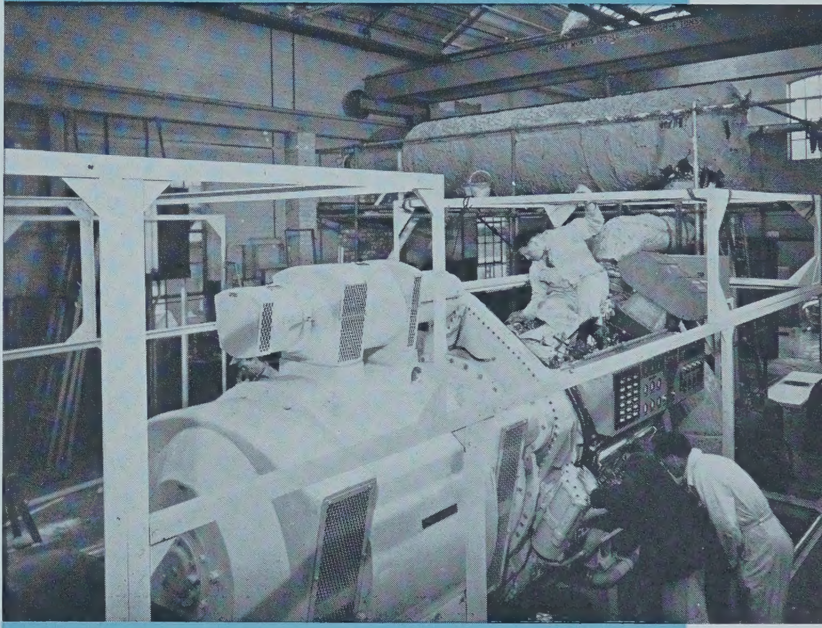
It is one-third of the weight of an alternator set of comparable power. The specific weight of a conventional set is of the order of 54 lb./kW., that of the Deltic set is only 20 lb./kW.

Weight-saving of this order acquires a special merit when the set is required at building or other engineering sites remote from a mains supply, or at sites inadequately served by the mains. It is an asset, too, when the set is needed as a standby. The Deltic installation not only needs less solid—and therefore less costly—foundations, but because of its compactness takes up much less space.

The Deltic set runs 5,000 hours between piston inspections—the equivalent of some 14 months of 12 hours-a-day running, seven days a week. When an inspection falls due the engine can be changed within a matter of a few hours and the work completed in a properly-equipped workshop.



Installation of Deltic alternator set nearing completion



Framework of the sound-proof booth in the course of erection

The sound-proof booth, housing the Deltic Alternator Set, completed

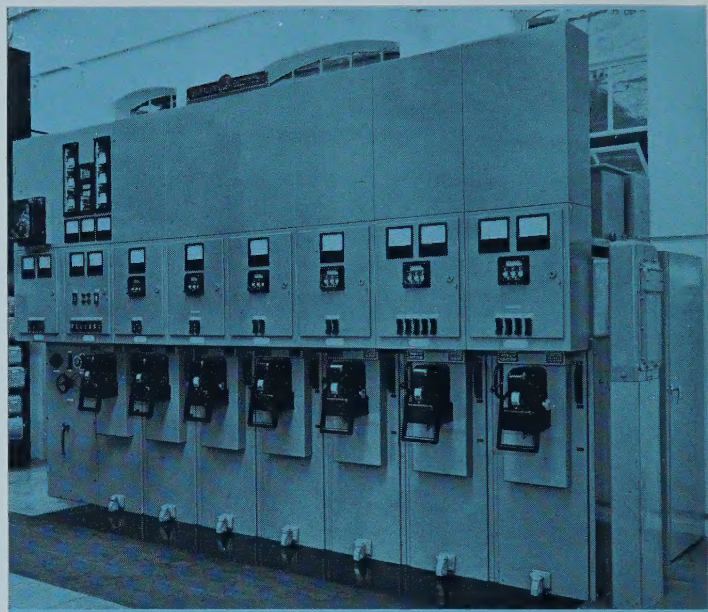
Both the alternator and the switchboard were designed and built by the English Electric Company Ltd. A description of the alternator, which is much lighter than a conventional alternator of the same power, appears below and a summary of the principal characteristics of the Deltic engine appears opposite.

With the same alternator, the Deltic can be supplied as a mobile set weighing only 29 tons having, at a rating of 1,200 kW., a specific weight of only 35.6 lb./kW., against the conventional set's 77 lb./kW. or thereabouts.

For the North American market the engine is offered for use at the 60 cycle synchronous speed of 1,800 r.p.m. with the same output—1,200 kW.

The Deltic is a post-war engine and one of the first of the new generation of high-speed diesels which are swinging the art and practice of diesel engineering into a new orbit. It is extensively used in fast patrol boats and coastal mine-sweepers of the R.N. and other navies, drives the generators of the world's most powerful single unit diesel-electric locomotive, and powers a fleet of fast passenger launches used to maintain a day-and-night ferry service between the shore and oil rigs on Lake Maracaibo, Venezuela. It has been chosen by the U.S. army to drive a compressor set forming part of a mobile liquid-oxygen plant, and for the main propulsion machinery of a fast patrol cruiser now being built for the Royal Canadian Mounted Police. Four Deltics are shortly to replace the two conventional marine diesels of a 17,000-ton ore carrier.

It is built in two forms, one with 9 cylinders, the other with 18 cylinders. Originally, neither was supercharged but now turbo-blown versions of both are in production.



The seven-panel English Electric O.L.X switchgear into which current from the Deltic alternator set is fed

Turbo-blowing has increased the rating of the 9-cylinder engine from 900 to 1,100 b.h.p., and that of the 18-cylinder engine from 2,500 b.h.p. to 3,100 b.h.p.

THE ENGLISH ELECTRIC LIGHTWEIGHT ALTERNATOR

The alternator is built to form an integrated unit with the Deltic engine. The alternator frame is a smooth rigid casting of aluminium and is flange-mounted to the engine phasing-gear case. The weight is taken by a fabricated steel keel to a resilient mounting which, together with two others, one at each side of the engine, gives a three-point suspension system perfectly suited to a mobile set.

The alternator is in a drip-proof enclosure and is axially ventilated. Provision can be made for fitting air filters if necessary. The stator core is of the usual laminated construction with a well braced hairpin type of winding. The insulation is Class B throughout. The rotor is cylindrical as opposed to the salient pole type of construction and the core is fully laminated. The winding is essentially a three-phase distributed type, connected in star and brought out to three slip-rings. For normal alternator operation the d.c. excitation current is fed in at one ring and out at the other two. This construction also provides for starting the set by using the alternator as an induction motor when a mains supply is available.

The main exciter, which is a two-bearing self-ventilated foot-mounted drip-proof machine, is gear-driven at 1,500 r.p.m. via a separate output shaft on the engine phasing gear case.

To ensure unfailing reliability and maximum stability of the excitation system the main exciter is separately excited from a level compound-wound drip-proof pilot exciter overhung from the non-drive end of the main exciter.

Class B insulation is used throughout and, notwithstanding the compactness of the overall assembly, the commutators and brushgear and general mechanical construction are particularly robust, and admirably suited for long life and trouble-free service with the minimum of maintenance.

The equipment is fully suppressed against radio interference.

The automatic voltage regulator is of the Brown Boveri quick-acting type and regulates the alternator voltage by controlling the field current of the main exciter.

A separate manually-controlled rheostat together with a hand/automatic switch is also provided.

DELTIC ENGINE TYPE 18-25B

The Deltic 18-cylinder Engine, Type 18-25B, has an output shaft running at crankshaft speed and is suitable for direct coupling to 50 cycle or d.c. generating plant.

Leading Particulars

Bore: 5.125 in. (130.17 mm.) Stroke: 7.25 in. × 2 (184.15 mm. × 2).
Swept volume: 5.384 in.^{3} (88.3 litres). Compression ratio: 16.4:1.

Performance

		1 hour	12 hour	24 hour
Output	b.h.p. (metric h.p.)	1900 (1925)	1725 (1750)	1550 (1570)
Crankshaft speed	r.p.m.	1500	1500	1500
Brake mean effective pressure	lb./sq. inch (kg/cm^2)	93.2 (6.55)	84.6 (5.95)	76.0 (5.34)
Specific fuel consumption	lb./b.h.p. p-hr. (gram/h. p-hr.)	0.373 (167)	0.375 (167.8)	0.380 (170)
Oil consumption	pints/hr. (litres/hr.)	— —	5 (2.84)	5 (2.84)

NOTES: Specific fuel consumption is based on fuel to BS 209 Class A having a lower calorific value of 18,500 B.Th.U./lb. (10,300 kg-cal/kg) and is subject to a tolerance of 5 per cent.

Oil consumption is subject to a tolerance of 10 per cent.

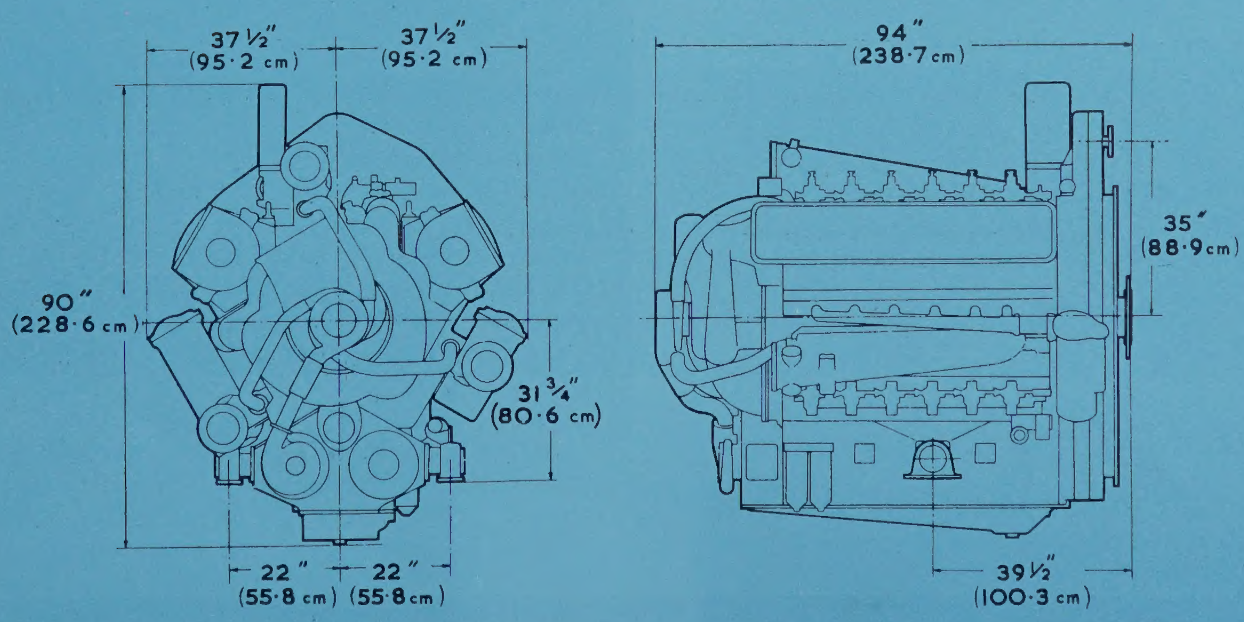
Performance figures are related to the following ambient conditions:

Mean barometric pressure	29.5 in. Hg (750 mm.)
Air temperature at intake	85° F. (29.4° C.)
Relative humidity	50 per cent.

Approximate Weight Summary

	lb.	(Kg.)
Net dry weight of engine complete with mounting feet and exhaust manifolds	10,130	(4,595)
Exhaust collector tank and connecting pipes	290	(132)
Oil (in engine only)	160	(76)
Coolant (in engine and exhaust manifolds only)	370	(168)

PRINCIPAL DIMENSIONS



Perpetuating Craft Skills

This is the age of specialisation, and companies employing skilled labour now tend to shape their apprentice schemes to meet their needs, both in numbers and in trades. The following article briefly surveys the history of apprenticeships in this country, and then describes the Napier system of training now in operation.

The apprentice system—the traditional method of passing craft skills from one generation to the next—has a history that goes back over many centuries. Contemporary records, in fact, cannot tell us when the system first began. In this country it was common at least 100 years before it was first mentioned, in 1383, in an Act of Parliament. It might have been in force for thousands of years before that in countries where civilisation had an earlier birth.

Few institutions have been more jealously guarded. The loss or decline of the means for maintaining and improving the standard of craft skills would mean the loss or decline of the craft skills themselves, to the peril of a country's prosperity and perhaps even its security.

As times have changed, so the apprentice has had new charters written for him. At one time his guardians were the Craft Guilds; it was they who prescribed the manner of his training and stipulated the terms of his apprenticeship. In 1563 the State assumed, by the passing of a Statute, the earlier functions of the Craft Guilds.

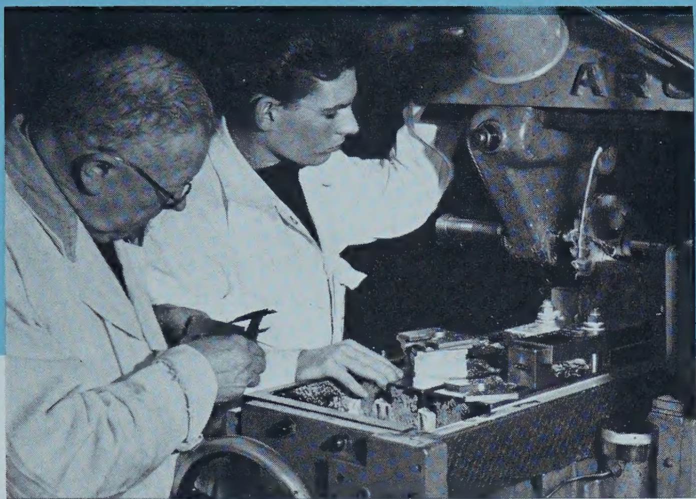
Typical factory workers of 40 years ago

Under the terms of the Statute the apprentice was required not only to be trained to a certain standard of skill but to live with the master craftsman who taught him—live as a member of the family so that he could also become familiar with the manners and social customs of master craftsmen at home and in business. The Statute also decreed that only those who had served an apprenticeship could set up as master craftsmen.

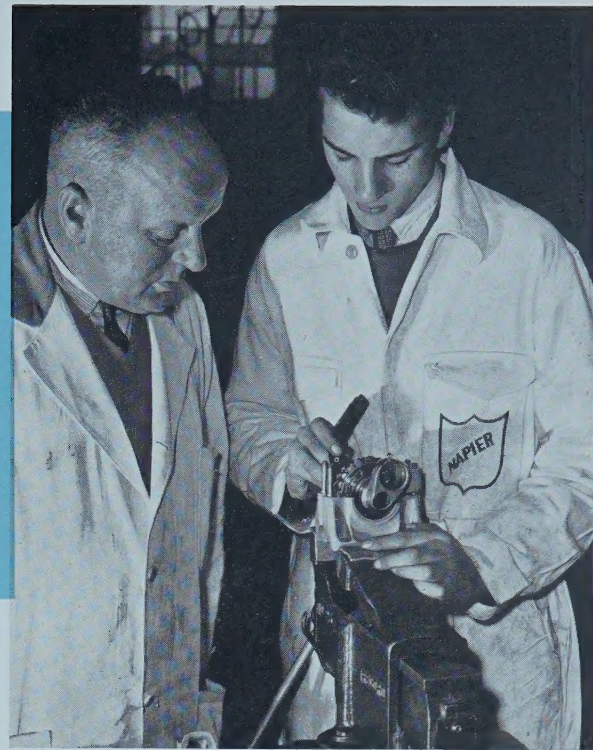
When the apprentice had completed his training he usually became a journeyman, moving from place to place where work was to be found. In due course, if he had mind to, he became a master craftsman and employed and taught others.

With the passing of the years and the growing use of machinery, the terms of the 1563 Statute fell into neglect. By the beginning of the nineteenth century the apprentice was tending more and more to live at home, and to draw wages. Men who had not served an apprenticeship were setting up in business on their own account on an increasing scale. Hence, in 1814, in order to bring the law into line with common practices, those parts of the Statute which no longer had force were repealed.

Late in the nineteenth century the rapid transfer of production from hand to machine tools in industry and the specialisation of manufacturing processes made the task of training apprentices both more difficult and more costly, and employers became increasingly reluctant to provide the facilities and find the money. The manufacturing industries were outside the reach of the apprentice laws and in a world of free competition and little State control, employers preferred to engage low paid juvenile labour to the training of apprentices.



. . . using a horizontal milling machine



. . . using a feeler gauge

It was then that the Trade Unions stepped in. They saw, even if the employers did not, an increasing threat to the status and supply of skilled men in industry, and they wisely took steps to ensure that training in craft skills associated with machine-tools was provided on as adequate a scale as it had always been in crafts associated with hand tools. They imposed on the employers a system of apprenticeship training closely resembling that enforced upon themselves six or seven hundred years earlier by the Craft Guilds. The new system not only prescribed the training which the apprentice had to undergo but also barred the employer from accepting at one time more apprentices than he could properly train.

During World War I the apprenticeship system in industry suffered grievously from the large scale withdrawal of skilled men for the Armed Forces and from the simplification of manufacturing processes in the interests of production. The restoration of peace was followed by a long period of industrial depression and disquiet and employers had little encouragement to train boys for a career that seemed to offer only the dreariest of prospects.

Government action saved the system from complete decay, and when World War II broke out and industry suffered an even greater upheaval, the system had been so firmly re-established that it hardly felt the impact of war.

To-day, it flourishes as strongly as ever it flourished. Practically all large firms which employ skilled labour spend hundreds of thousands of pounds a year on the training of apprentices, and small firms are tending more and more to form groups among themselves so that they, too, can play their part in the essential process of ensuring that the skill of one generation passes on to the next. The need for continuity was never more urgent.

No record has come down to this day of the name and trade of the first Napier apprentice, but a note in the company's files discloses that an organised scheme of apprentice training was in force as long ago as 1835. Nevertheless, it is more than probable that the apprentice was a familiar figure in the Napier workshops many years before that.

At the beginning of 1958 no fewer than 385 boys and young men were being trained as apprentices in the company's London area workshops and offices. The largest class—205—were Craft apprentices who, when trained, will become craftsmen fully qualified to take their place alongside older men of their own trade—turners, millers, sheet metal workers, pattern makers, machine tool-setters, gear-cutters, tool room machinists, and the other craftsmen who provide the talent upon which all production processes are dependent.

Sixty-one of the 385 boys were Technician apprentices. When trained they will become technical assistants and be employed in drawing offices, testing, development, or production, with full scope to reach positions of responsibility appropriate to their abilities. Both Craft apprentices and Technicians serve a five-year apprenticeship.

Students, whose training takes from four to five years, numbered 89. They will become technical assistants with rather greater responsibilities and scope than Technicians. They are employed on research, design, development, works

Back row: Instructors: W. Fisher, F. Pleasants, A. Jones, E. Woollacott
Middle row: Mr. O. G. Seymour (Chief Instructor), Mr. R. J. Perkins (Deputy Chief Instructor)
Seated: Mr. F. H. Bonney (Apprentice Supervisor), Mr. J. F. A. Radford (Chief—Personnel and Training), Mr. J. C. Darley (Education Officer)

administration, production, or sales and service in the Commercial Division.

Graduates, in common with the best of the Students who have graduated, are those whose qualifications fit them for training for senior appointments in the company. At the beginning of 1958 Napier had 30 Graduates under training.

CRAFT APPRENTICES AND TECHNICIANS

On an average, Napier receive fifteen times as many applications for Craft apprenticeships as there are apprenticeships available. Every applicant is invited to attend an interview. About fifty per cent. are eliminated at this interview; the rest are asked to take a simple examination designed to test their knowledge of elementary mathematics and their skill in the use of English. The final selection is made on the results of this examination.

The successful applicants, who are 16 or 17 years old—or 15 if a prospective Craft apprentice—spend their first three months in an office, during which time they become familiar with the location of the different departments and with the names of the various departmental chiefs.

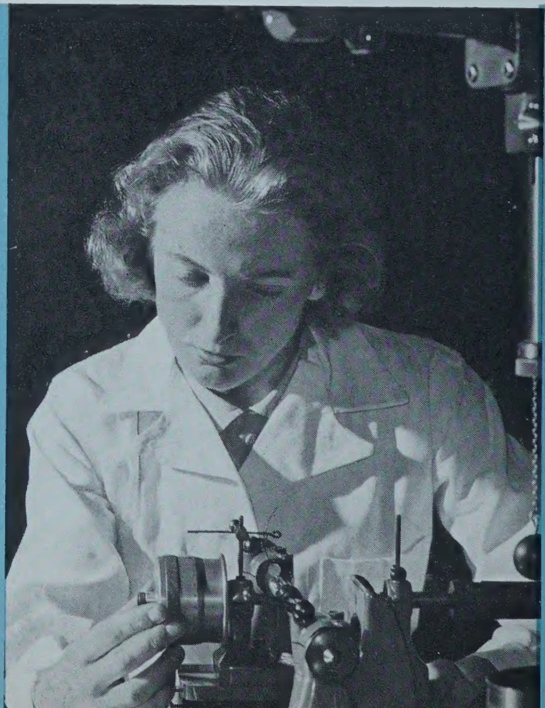
All apprentices spend a period in the Napier Apprentice School, learning to use the hand tools of their trade, the simpler forms of detail fitting and the use of standard workshop machine tools.

At the end of the training period Craft apprentices start work in the factory, moving from one department to another so that they can discover the kind of work they like best, or for which they have most aptitude.

As they learn the practical side of engineering so they study the theoretical by regular attendance at a technical college. At the age of 19, after completing at least two years of training and study, they take an examination, and on the result largely depends the course of their career.

If they distinguish themselves they may be up-graded to Technician or Student. Otherwise, they are assigned to the trade of their choice and grow proficient in that trade during the final three years of their apprenticeship. In the last phase of their training they can take an examination for the City and Guilds Craft Certificate, or, in special cases, the National Certificate in Mechanical Engineering.

. . . a draughtsman and his instructor



. . . a girl graduate apprentice

Apprentices who are trained as Technicians are chosen from among those who are 16 or 17 years old, and have a General Certificate of Education (Ordinary) in Mathematics, Physics, or General Science, English and one other subject, or have come from a Technical School with a pass in, or exemption from, the S.I. examination of the Ordinary National Certificate. They also attend a technical college course for the Ordinary National Certificate leading to the Higher National Certificate.

STUDENTS AND GRADUATES

Students, who begin their training when they are 18 or 19 years old, take " Sandwich " courses at technical colleges over a three to five year period studying for a Diploma in Technology, or Higher National Diploma in mechanical or production engineering. Their practical experience is gained in the workshops and offices in their chosen branch.

Graduates take a two-year course. They already hold a degree in engineering or engineering science, or a Higher National Engineering Diploma. During the second year, they take a post-graduate course of studies appropriate to the branch of engineering in which they are training. Their practical training consists of a condensed period of basic training and appropriate experience in workshops and technical offices.

Craft apprentices, Technicians and Students who reveal exceptional abilities are, if vacancies exist, up-graded, and it is possible for a Craft apprentice to become a Student, or even a Graduate.

Besides being paid during training, Napier Craft and Technician apprentices who apply themselves diligently to their studies and practical work receive annual " Merit Awards "—vouchers which range in value from £2 to £20, the highest amounts being awarded to apprentices in their last year of training. These awards assist apprentices to buy tools and books to help them in their training.

At the Annual Apprentices' Prizegiving special prizes—which include the " Company's Trophy," and the " Foremen's Trophy "—are awarded to those whose work and personal qualities have shown them to be outstanding in their grade.

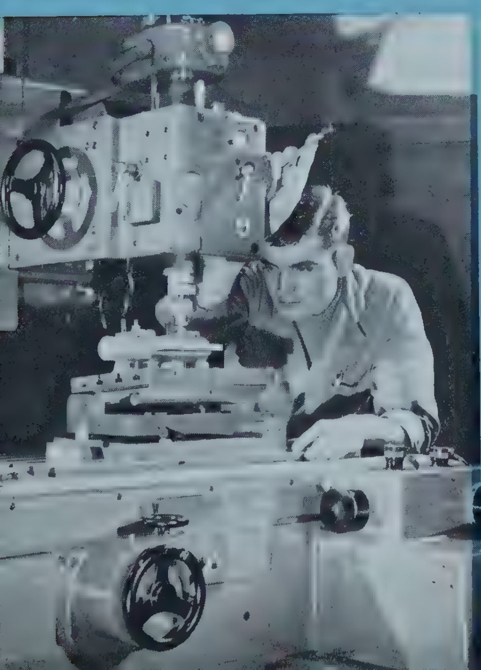
Most apprentices, whatever their grade, belong to the Apprentices' Association, a lively, self-supporting body which engages in many social activities, has a strong sports section and publishes its own magazine, " The Blower."

Other Napier apprentices are trained at the Luton and Liverpool factories under a joint scheme with English Electric apprentices.

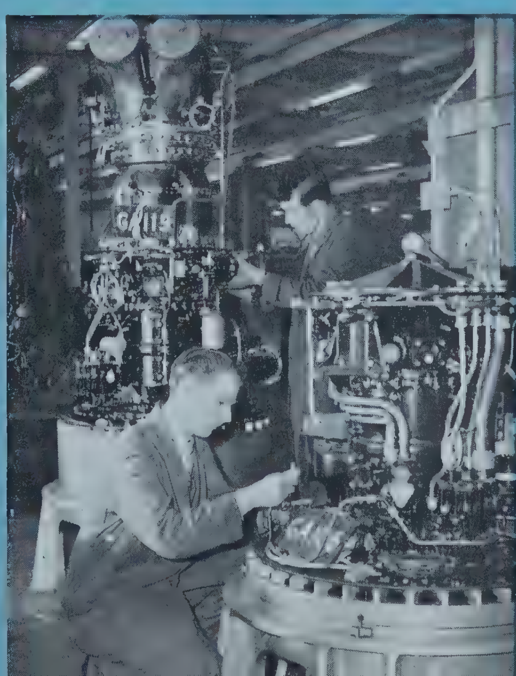
Those whose memories of engineering apprenticeship go back 50 years may be forgiven for thinking that the apprentice of to-day is a member of a very pampered and privileged class. The old-time apprentice started work in a certain trade, and that trade often remained his for life. Those who wanted to test their skill at, or aptitude for, another trade had to wage a private war to get their way. No system was in force in which boys were moved from trade to trade under a training scheme designed to develop their natural talents to the fullest degree.

The old system, of course, would never serve modern needs. Paradoxically, although the use of automatic machines is rapidly increasing and one automatic machine, unaided, may perform half a dozen separate operations on a single component, a modern engineering workshop demands a standard of skill higher than that demanded by any workshop of the past. Nor does its demand fall entirely upon manual dexterity. Skilful hands must be allied with competent brains if industry is to advance at the speed made possible by recent inventions and scientific achievement.

. . . operating a jig borer



. . . engine assembly



. . . using a micrometer

Eland Progress

CANADA BUYS THE ELAND-CONVAIR

The Canadian Government has ordered from Canadair Limited ten Eland-engined medium-range transports as a step in the modernisation of the R.C.A.F. Air Transport Command's equipment. The order was placed in February and deliveries of the new aircraft are to begin next year. The airframe is basically that of the well-known and widely-used Convair 440 Metropolitan, and the type will be known in the R.C.A.F. as the C.L. 66.

The order is a triumph for the Eland. The R.C.A.F.'s interest in a turbo-prop transport was known and the choice of the Napier engine was made in the face of keen competition from aero-engine and aircraft companies in the United States and in this country.

The C.L. 66 is backed by powerful industrial interests. Convair, who designed and manufactured the original Convair series of twin-engined airliners, is a United States aircraft company with a world-wide reputation and a member of the General Dynamics Corporation of America. Canadair, one of the largest aircraft companies in Canada, is also a member of the General Dynamics Corporation. Napier, makers of the Eland, add still greater industrial weight to the new venture, as members of the English Electric Group which operates over a wide range of industries and commands immense resources.

For the production of the C.L. 66, Canadair will use the jigs formerly used by Convair at their San Diego, California, works. The Elands will be supplied as complete powerplants—that is, with the engine, its accessories, propeller, oil and hydraulic tanks, firewalls, cowlings and control connections, in one unit—so that the work necessary on the final assembly line can be reduced to the minimum.

Canadair and Convair are confident that the new air transport will have a world-wide appeal and that its sales to the airlines might even exceed those of its immediate predecessor, the popular piston-engined "Metropolitan." As an airliner, the Canadair C.L. 66 will have an all-up weight of 53,200 lb., and a crusing speed of 326 m.p.h. Payload will range from 44 to 60 passengers, or 10,000 to 15,000 lb. of cargo. Maximum range will be 1,700 miles.

A vigorous sales campaign is being planned and more than one airline is known to be already interested in the new airliner.

Externally and structurally, it will differ little from the Convair 340 which Napier converted to Eland power and which is now in the United States, undergoing airworthiness tests set by the Civil Aeronautics Administration of the United States Department of Commerce. The Eland-Convair was flown to the United States last autumn and on the way was demonstrated to the R.C.A.F.

" ELAND " PASSES TYPE TEST AT 3,500 E.H.P.

The Napier " Eland " propeller turbine aero-engine has passed a 150-hour Type Test for civil use at a sea-level take-off rating of 3,500 e.h.p.

A Certificate of Approval has been issued by the Air Registration Board, and a copy, with other relevant documents, has been sent to the C.A.A. for endorsement and approval.

The " Eland " has also passed, at the same rating, a 150-hour military Type Test under conditions laid down by the British Ministry of Supply.

A brief summary of what a Type Test involves, together with some of the figures relating to the Eland's type testing, appears on page 26.

THE TRANSATLANTIC CROSSING

The Eland-Convair took off for its transatlantic flight from its base at Cranfield, near Bedford, on the afternoon of November 15th. It refuelled at Prestwick airport, Scotland, then flew to Keflavik, Iceland. It left Keflavik the next day, reached Goose Bay, Labrador, refuelled, left for Ottawa, and arrived there the same day. It remained at Ottawa for a week, leaving on November 23rd for Minneapolis. It remained there one day, then flew non-stop—a distance of 1,381 nautical miles (1,592 statute miles)—to Santa Monica, California, to begin its airworthiness tests.

From the take-off at Cranfield to the touch-down at Santa Monica (excluding the R.C.A.F. demonstrations), the Eland-Convair covered a total distance of 5,371 nautical miles, logged 25 hours 46 minutes flying, and recorded an average speed of 208.5 knots (240 m.p.h.) over the whole trip.

DEMONSTRATION TO THE R.C.A.F.

During its stay in Canada, the Eland-Convair gave six separate demonstrations to officials and officers of the Royal Canadian Air Force. On one flight the airliner carried an all-Canadian crew, with Napier's pilot sitting in the second pilot's seat to give advice and guidance as necessary. Time did not allow the Canadians to make a full evaluation of the aircraft, but the Canadian crew investigated weight,

The crew which took the Eland-Convair 340 to America. Left to Right: S. A. Sharpe (Navigator), T. Burke (Co-Pilot), R. J. Marley (Radio op.), B. Jones (Flight Eng.), Mike Randrup (Captain), T. J. Riddell (Electrics), N. S. Bruce (Propellers), C. J. Palmer (Airframe), P. J. Mepham (engines)

Left: L. A. Sanson, Napier's Canadian Representative, talking to Group-Captain C. H. Mussells, D.S.O., O.B.E., D.F.C., C.D., Station commander, Uplands R.C.A.F. base, Ottawa, after a flight in the Napier Eland-Convair

engine starting, ground handling, take-off, climb, stall, general handling, assymetric handling and engine handling. Miscellaneous systems were tested and approach, overshoot, and landing characteristics observed.

At the time, the Canadians said that they were impressed with the aircraft's performance and the subsequent order from the Canadian Government confirmed the high opinion formed of the aircraft by those who flew, or flew in it.

C.A.A. AIRWORTHINESS TESTS

Good progress is being made in the heavy programme of tests involved in the C.A.A. airworthiness certification of the Eland-Convair. A number of the tests have been completed and others are nearing completion.

The airworthiness tests are being sponsored by the PacAero Engineering Corporation on behalf of the owners of the Eland-Convair, and this company is supported by a strong team of engineers from the Napier organisation. The team includes Mr. K. H. Greenly, Projects Manager of the Flight Development Establishment, and Mike Randrup, the chief test pilot.

WESTMINSTER-ELAND

Two Napier 229 engines have been sent to the Yeovil, Somerset, works of Westland Aircraft Limited for installation in the prototype of the new Westminster helicopter. The Westminster is a 40-seat airliner (or, alternatively, a military transport), but a " flying crane " version, capable of lifting 15,000 lb. ($6\frac{1}{2}$ tons) is being built first.

The " crane " will have an airframe of welded tubular construction devoid of fairings but the pilots' cockpit in the nose will be fully enclosed. The absence of fairings simplifies manufacture and maintenance and lowers the cost of manufacture.

In both versions the two Elands lie side-by-side on the top of the fuselage ahead of the main rotor shaft, enclosed by cowlings.

Power from the Elands is transmitted by shaft, at engine speed, to a two-stage reduction gear box. The first stage consists of two trains of gears, one for each engine, with a ratio of 3.83 : 1. A combined output shaft transmits the power to the second stage. Two free wheel devices in the transmission system prevent the failure of either engine from throwing a load on the other.

The two-stage gear box is part of the rotor transmission system and is attached to the aircraft. The hydraulic clutch for engaging and dis-engaging the high-speed transmission shaft forms part of the engine.

A dual-purpose model showing the Westminster airliner and " flying crane." This helicopter has an overall length of 86 ft. 9 in., an overall height at the tail rotor of 23 ft. 6 in. The main rotor has a diameter of 72 ft., the tail rotor one of 15 ft.

More power for Demodocus

NAPIER-BLOWN HARLAND-B & W ENGINES

The 9,000-ton Blue Funnel Cargo Liner Demodocus

Demodocus entered service in September, 1955, and was the first of six similar vessels ordered by Messrs. Alfred Holt & Co. with Napier turbo-charged Harland-B & W opposed piston engines.

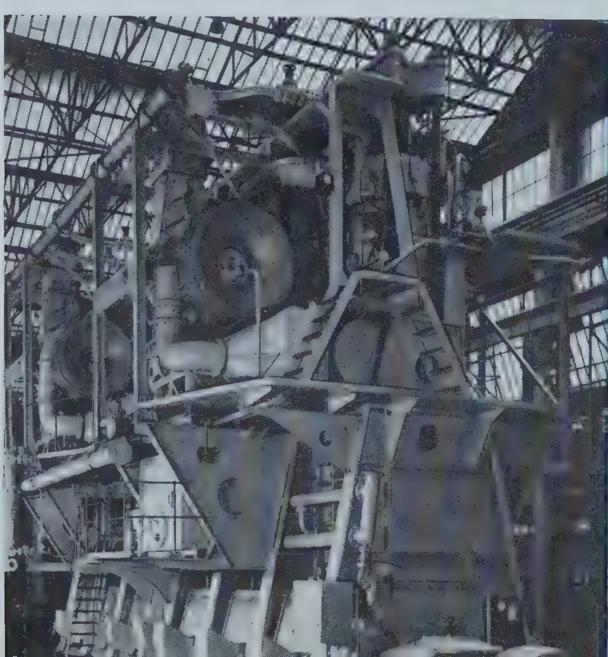
The *Demodocus* is a ship of advanced design and in service has proved to be one of the most efficient cargo carriers of her class. Designed for a service speed of 16 knots she has averaged 16.2 knots over a full speed distance of 65,877 miles on a daily fuel consumption of 28.52 tons (boiler oil) for all purposes.

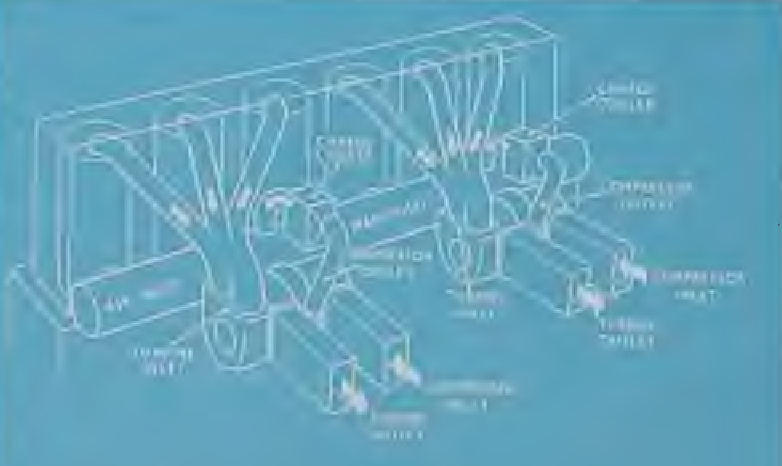
Demodocus is 487 ft. in length overall with a beam of 35 ft. 2 in. moulded and a loaded draught of 28 ft. She and her sister ships are based in design upon the owners' *Bellerophon*, the dimensions being similar, but in place of 7-cylinder non-turbo-charged two-stroke machinery of 7,250 b.h.p. is a 6-cylinder turbo-charged Harland-B & W engine of 8,000 b.h.p., an output which in the two final ships *Menestheus* and *Menelaus* has been increased to 8,500 b.h.p.

This was the first large single-acting, two-stroke, eccentric type diesel engine built by Harland and Wolff to be turbo-charged. The engine has a bore of 750 mm. and a combined stroke of 2,000 mm. As a result of pressure charging the continuous service power is increased by 30-35 per cent. as compared with the non-turbo-charged engine.

Scavenge air is supplied by two Napier Type M.S. 600 exhaust gas driven turbo-blowers. The air is drawn from the engine room into the blower through a combined filter/silencer and is delivered to the scavenge air manifold through a charge air cooler. The exhaust gases after passing through the turbines which drive the blower are delivered to a La Mont boiler, raising the steam necessary for ancillary purposes at sea, including that needed for the distilling plant. A diagrammatic arrangement of the turbo-blowers is shown below.

The first three vessels of the *Demodocus* class were fitted with electric motors of 10 h.p. arranged to drive the turbo-blower through automatically controllable "airflex" clutches to allow turbo-blower operation to be continued right down to minimum operating power requirements including manœuvring. When the exhaust gas energy was sufficient to give self-supporting operation of the turbo-blower (20-25 per cent. engine power) the electric motor automatically disengaged. On later ships of this class the system was superseded by the Napier Auxiliary Air System, which will be described in the next issue.





Above : Diagrammatic arrangement of turbo-blowers

Left: The 8,000 b.h.p. Harland-B & W engine of the Demodocus, showing the Napier turbo-blowers

Fighting Ice in Flight

This photograph demonstrates the efficiency of the Napier " Spraymat " surface heating system of de-icing for aircraft. Under simulated conditions ice has formed thickly on the blades and engine nacelle, but the spinner nose and the air intake, both protected by " Spraymat," remain clear

Aeroplanes which have to fly in all weathers run a risk of having ice form on their airframes or engines with, perhaps, calamitous consequences. For this reason, many of them are provided with means for preventing ice from forming (anti-icing) or for disposing of ice (de-icing) before it reaches dangerous proportions. If allowed to build up, the ice will destroy the aeroplane's lift, the efficiency of its fin and tailplane and choke its engine(s). In addition, the weight of ice creates its own hazards.

Conditions favourable to ice formation exist in clouds of low ambient temperature (below 0° C.) in which there are super-cooled droplets of water above a certain size. On impact with the aeroplane the droplets turn into ice and start the icing-up process. The principal points of attack are the leading-edges of wings, fins and tailplane, and engine air intakes. The inlet guide vanes of a jet engine are particularly susceptible to icing.

There are three types of ice—slush, glaze and rime—and three rates of icing—instantaneous, intermittent and maximum continuous. Slush ice is loose and is not difficult to dispose of; the other two types adhere strongly and present a bigger problem; they form at lower ambient temperatures.

When icing first became a problem attempts were made to deal with it by smearing a paste over leading-edges of wings, fins and tailplanes. The action of this paste lowered the freezing point of water so that droplets remained fluid after impact. The method was not very satisfactory; a sharp shower was sufficient to wash off the paste and once this had happened the aeroplane was again vulnerable to the onset of icing.

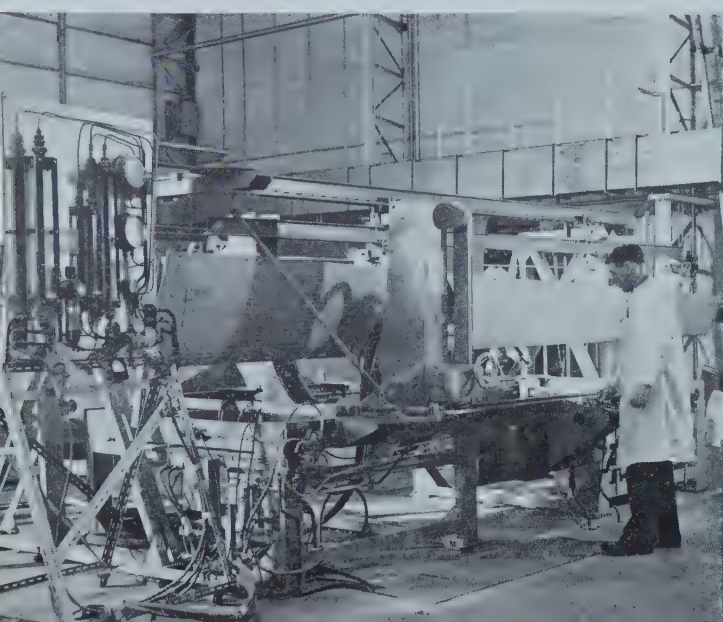
Later, attempts were made to introduce a system in which fluid that lowered the freezing point of water was fed to the leading-edges through porous metal mats, but here the difficulty lay in obtaining an even distribution over the surface to be protected. Furthermore, so much fluid had to be carried to meet every contingency that the aeroplane's payload suffered a reduction too large to be borne.

A more satisfactory method was found to be the fitting of rubber shoes over the leading-edges. When ice forms, the shoes are alternately inflated and deflated; this cracks the ice, which is then swept off by the airstream, but because the method imposes aerodynamic limitations it cannot be fitted to very fast aeroplanes.

Thermal ice protection systems have largely displaced those using chemicals. The most commonly used method feeds hot air to the inside of the aircraft's structure to heat areas vulnerable to ice formation. The hot air is ducted

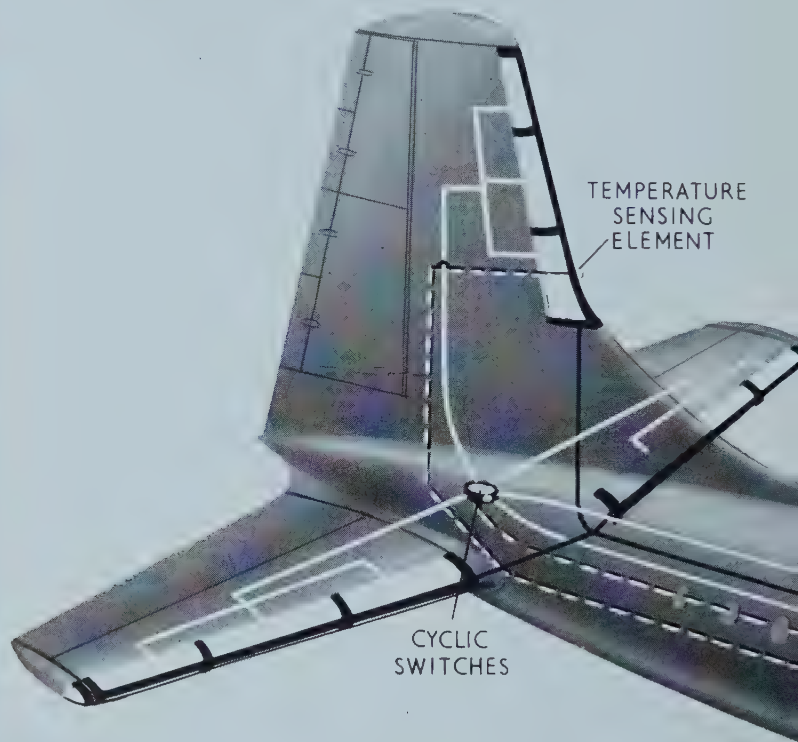
The spinning rig on which "Spraymat" materials are tested for rain erosion characteristics, water being sprayed from the perforated container above the mats

The "Spraymat" system being applied mechanically to the leading-edge of a Britannia tailplane

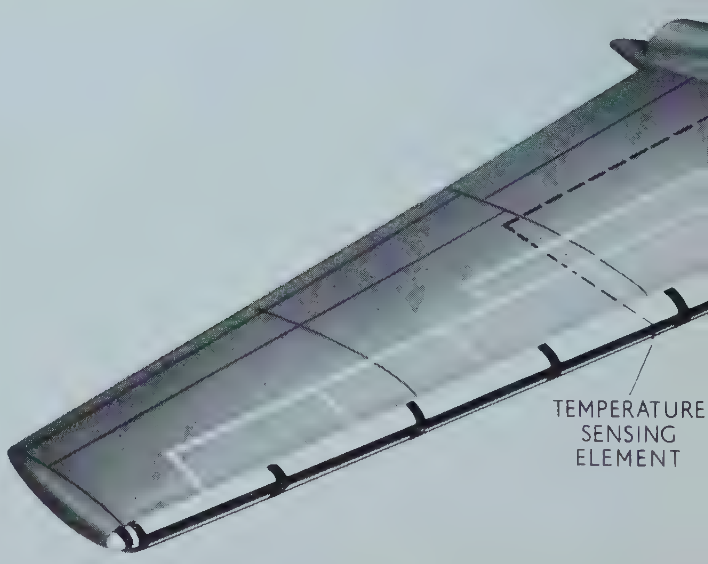


from special paraffin-burning heaters, or direct from a turbine engine's compressor, or from a heat exchanger around the jet pipe. The system is comparatively simple to design and install, but is somewhat wasteful, as only a small proportion of the heat reaches the areas to be protected. The remainder is lost in the ducting.

More recently, electro-thermal heating systems have been



CONTINUOUS ANTI-ICING
CYCLIC DE-ICING
— — — CONTROL CIRCUITS

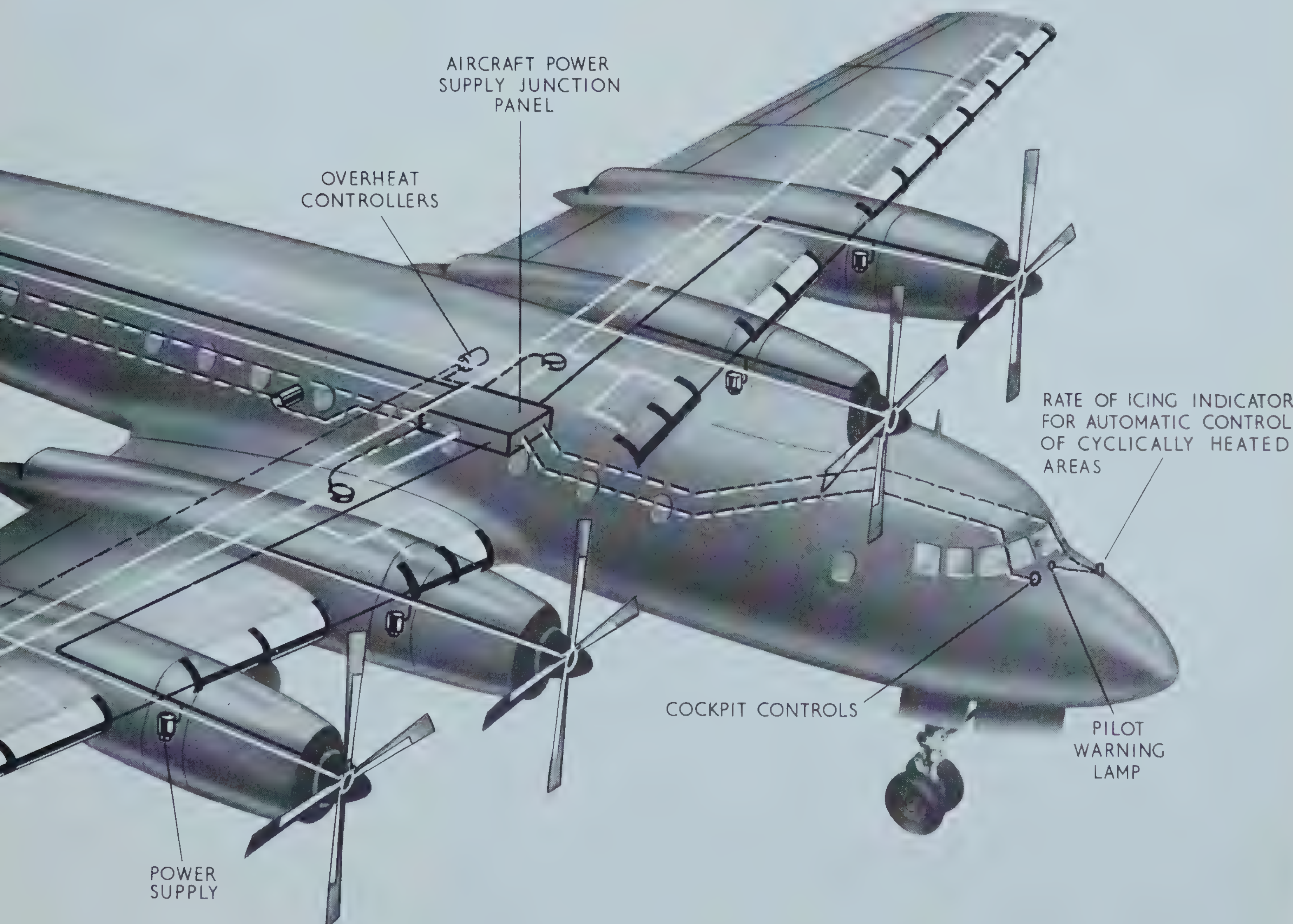


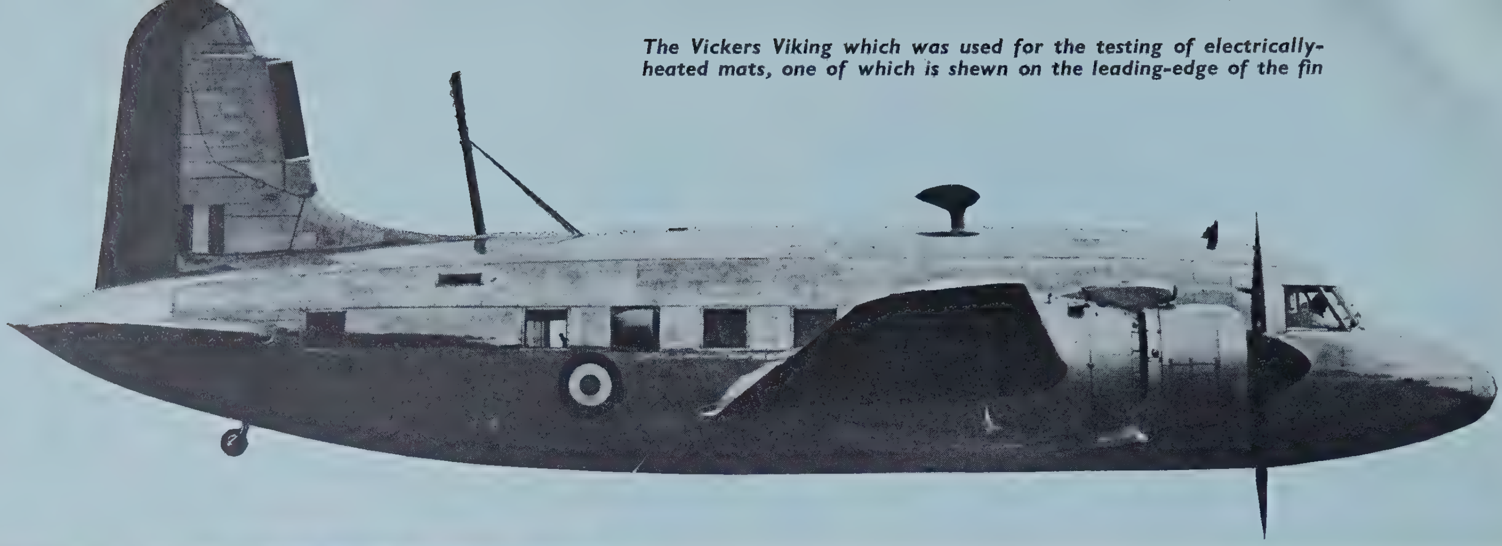
developed and these are solving problems which no other earlier method could solve. Among the new systems is " Spraymat," which was evolved and developed by Napier's Flight Development Establishment at Luton, Bedfordshire.

Experiments from which the "Spraymat" system grew began with a Hawker Tempest fighter bomber which was flown for about 100 hours in a variety of different conditions

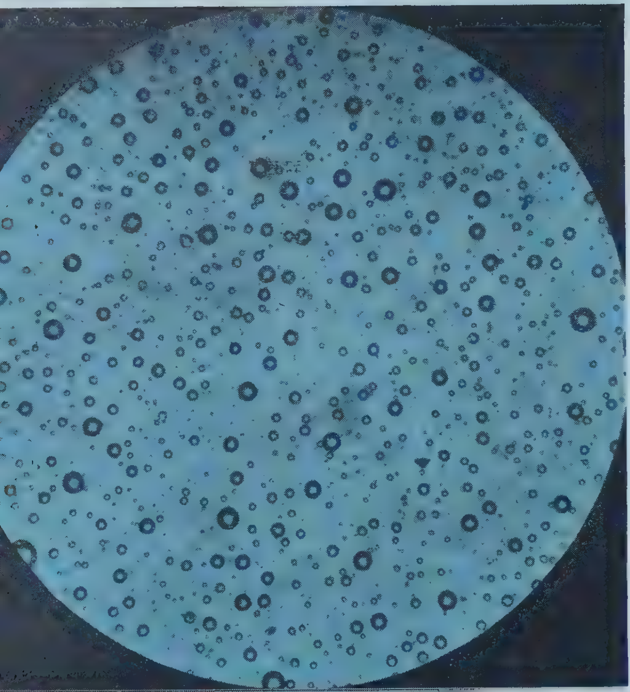
A Britannia fin leading-edge under a battery of infra-red lamps during the "curing" of its first layer of insulating material

TYPICAL APPLICATION OF NAPIER SURFACE HEATER ELEMENTS





The Vickers Viking which was used for the testing of electrically-heated mats, one of which is shewn on the leading-edge of the fin



at ambient temperatures down to minus 48°C. They were continued with an Avro Lincoln bomber which, to create artificial icing conditions when they were required, had a forward boom carrying a spray rig. Water was sprayed from 43 nozzles into the ducted spinner of the Napier Naiad propeller turbine engine and the results were filmed by a camera mounted on the boom.

A typical droplet sample, taken during icing trials

The spray rig used in Eland icing tests with a Vickers Varsity

More trials were completed with a Fairey Spearfish. Later, a Vickers Viking was used, and it was on this aeroplane that the most significant developments took place.

"Spraymat's" popularity can be attributed to its efficiency, its light weight, its small thickness, its versatility and the ease with which it can be applied even to the most complicated compound curvatures. It weighs only 0.27 to 0.32 lb./sq. ft. of protected area, and has a thickness of no more than 0.020-in. to 0.050-in. Its heating characteristics can be graded to meet the local icing danger—that is to say, where ice forms most extensively, or most dangerously, there the heat is greatest.

It can also exploit to the full the advantages of cyclic operation. During icing conditions, heat must be applied continuously to certain areas, but elsewhere it can be applied for short periods and switched off for the remainder of the time. Cyclic operation makes the most economical use of power; if all the heater elements were in use at the same time, the power consumed might prove to be an unacceptable load. But to be successful, the build-up of heat during the "on" period must be very rapid; this is a characteristic of the "Spraymat" system.

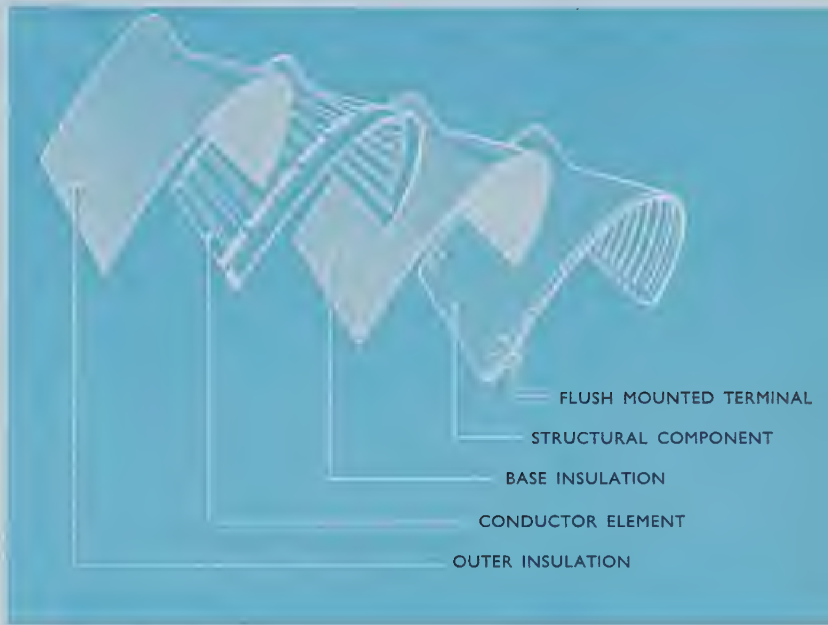
Among the areas continuously heated are the leading-edges and chordwise parting strips. This is necessary because otherwise an ice cap could form and be held in position by the airstream. The parting strips separate adjacent cyclically-heated areas and ensure the clean shedding of ice from each area.

The working voltage is 6–440 V. a.c. (Single or three-phase), or d.c., and elements with a loading of up to 40 kW/sq. in. can be provided. The heating uniformity of the elements is ascertained by checking the voltage drop over every 1 in. or $1\frac{1}{2}$ in. for the full length of the conductor element and adjusting the thickness locally.

There are two types of "Spraymat" heater. Type 1, which is applied wholly by various spraying processes (hence the name) and Type 2, developed from it, in which different materials are used, the method of application being partly by brushing and partly by spraying. The chief distinction between the two types, however, is in the curing temperatures of the synthetic resin insulation. Type 1 is cured at 180° C., Type 2 at 80–100° C. Both types of heater consist, basically, of (*a*) layers of insulating material applied to the structure which also serve as an adhesive to attach the heater, (*b*) the flame-sprayed metallic heater element, and (*c*) layers of insulating material sealing the heater elements.

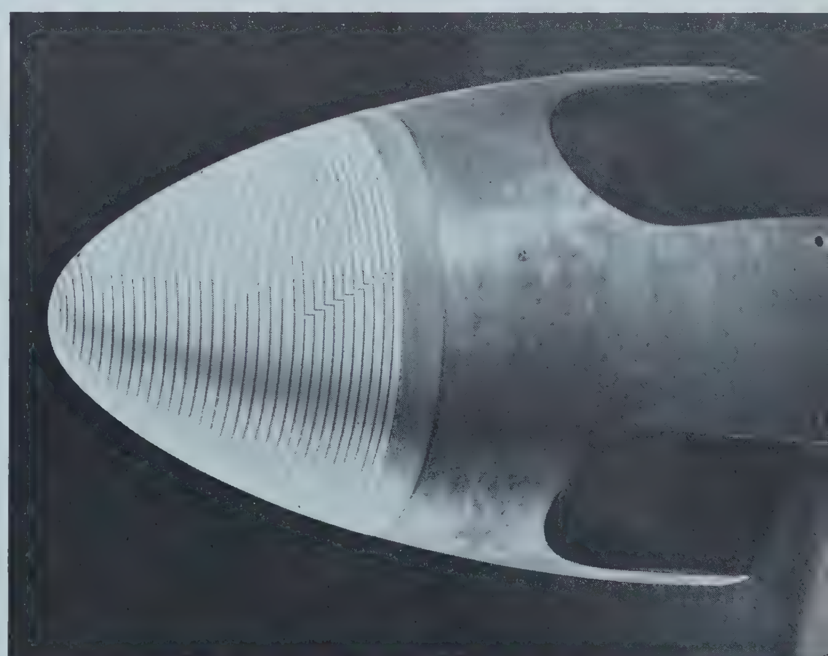
Type 2 heaters are now the more commonly used. The base insulation, a synthetic resin, is brushed on, and reinforced with glass cloth (one or two layers according to application), the resin being cured at 80–100° C. After curing, the heater elements, which are of aluminium or Kumanal (a copper-manganese alloy) are sprayed on in parallel strips by flame spray gun. The element pattern is outlined on the base insulation by thin strips of masking tape, cut to the exact widths (0.050 in. to 0.080 in.) of the insulating gaps. After spraying, these are removed, leaving metal-free gaps between elements. Busbars (narrow conductive strips) connect the end of one main strip to the next at a change of direction of 90 deg. or 180 deg. They are made by spraying a layer of copper over the aluminium or Kumanal.

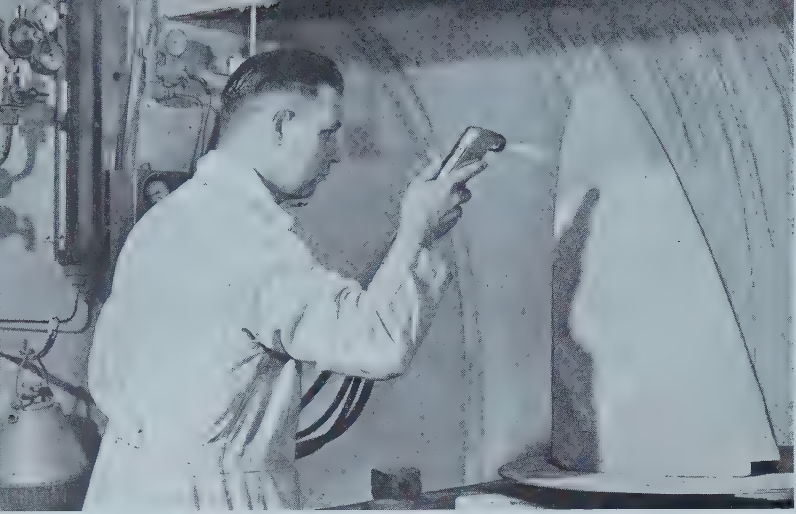
The outer insulation is brushed on in the same way as the base insulation, but the glass cloth reinforcing is omitted.



Napier "Spraymat" electrical de-icing

The pattern formed by the heater elements on the propeller spinner of the Eland-Convair airliner





An elevator horn balance having its aluminium conductor element sprayed on by flame gun

Testing the voltage drop of the heater elements to ensure uniformity of heating intensity

Components up to 24 ft. long may be oven-cured. For larger components, banks of infra-red heaters must be specially arranged. A particular advantage of the Type 2 heater is that it can be applied to many structures which, for one reason or another, may not be heated to over 100° C. One example is a Redux-bonded structure, in which the bonding would fail if it were heated to more than 100° C.

The use of Type 1 heaters is now confined to components with a degree of double curvature that would cause the glass cloth to bunch or wrinkle. Only aluminium heater elements are used on Type 1 heaters, and the base and outer insulation layers are applied by a flame spray gun supplied with a thermo-setting synthetic resin in powder form. The resin is oven-cured at a temperature of 180° C.

In certain applications a special protective coating is applied over the surface of the outer insulation. This increases the resistance of the heater to impact damage by hail or runway debris.

" Spraymat " has a dead smooth finish and when the part protected is painted—any colour can be used—no external evidence normally exists to show that it has had the system applied to it. Such evidence as exists is found on the inside of the structure in the form of electric terminals and wiring.

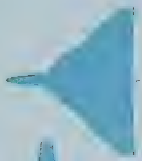
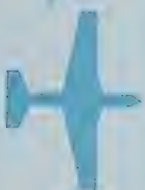
Finally, " Spraymat " can be applied to all metallic materials and to many non-metallic. It is completely water- and weather-proof, resistant to most acids and alkalis, and impervious to all aircraft fuels and oils and hydraulic fluids. It needs but little maintenance attention and if damaged can easily be repaired. Moreover, it can be applied to components to which it would be difficult or impossible to apply other systems, and it can be used either as an anti-icing or as a de-icing system.

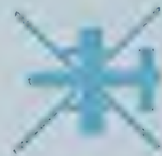
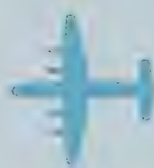
INDUSTRIAL APPLICATIONS

This article has dealt only with aircraft airframe and engine applications, but " Spraymat " has been applied to a much wider field. It has been used in industry, for many research and production processes—from the temperature control of test equipment to the de-frosting of refrigeration plant.

Ice peril at Sea

AIRCRAFT APPLICATIONS

	AIRCRAFT	COMPONENTS
	**Vulcan**	Pitot head mast.
	**Beverley**	Combustion heater air intake.
	**Britannia**	Fin and tailplane leading-edges and elevator horn balance.
	**Comet**	Alternator and jet pipe cooling scoops.
	**Gannet**	Engine air intake.
	**AW. 650**	Fin and tailplane leading-edges.
	**Caravelle**	Air brakes.

	AIRCRAFT	COMPONENTS
	**Rotodyne**	Engine air intakes and spinners.
	**Friendship**	Alternator cooling duct, heat exchanger intake, fin and tailplane leading-edges.
	**Victor**	Engine intake components.
	**Vanguard**	Fin and tailplane leading-edges.
	**Viscount 810**	Rudder horn balance.
	**Eland-Convair**	Engine intake, spinner, heat exchanger and generator cooling scoops.
	**Canadair Argus**	Elevator horn balances.

Overseas licensees for the " Spraymat " system of de-icing are:

U.S.A: The PacAero Engineering Corporation,
Santa Monica Airport,
Santa Monica,
California.

FRANCE: Bronzavia, S.A.,
207, Boulevard Saint-Denis,
Courbevoie (Seine),
Paris.

THIS WAS NAPIER

David Napier, the Scot who, in 1808, founded the Napier business which still bears his name, first won fame as the designer and maker of printing machinery. For 10 to 12 years after setting up as an engineer in London he made no attempt to specialise, but in 1820 he was commissioned by an American, Daniel Treadwell, to make a printing press worked, appropriately, by treadle.

This commission, and another from a man named Rutt—and, no doubt, repair work on other printing presses—must have revealed to Napier, the perfectionist, some of the shortcomings of current designs and encouraged him to exercise his inventive genius, because a few years later he produced a printing machine of his own design. His principal object was to save labour, and his machine was full of novel and ingenious devices, but needed so much time for " make-ready " that it defeated its own ends.

However, he found customers for at least two of these machines, and the reputation for high-class craftsmanship which he had already made in no way suffered. T. C. Hansard, the Parliamentary printer, and one of the country's foremost authorities on print and printing, must have seen merit in the Napier design, for he placed an order with its inventor for a machine of considerable size and capacity—one that printed on both sides of the paper in a single operation.

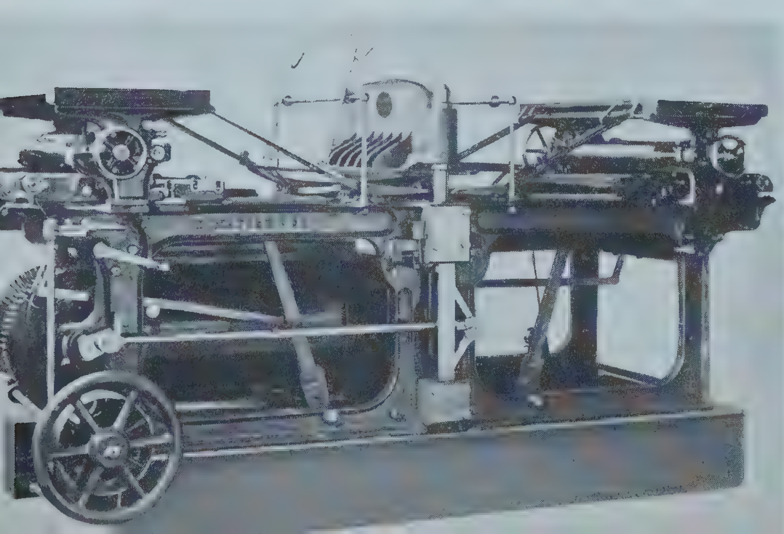
Once more Napier strode ahead of contemporary practice. Instead of tapes to guide the paper to and round the cylinders he used steel grippers, which gave more accurate register and were less liable to break. He also arranged the cylinders carrying the paper to rise clear of the moving forme of type and to make contact with it only at the moment an impression was required.

In his book " Typographia," Hansard described the action of the steel grippers in the following words : " *This beautiful mechanism is contained in the interior of the impression cylinders, which have openings along their circumference, through which the* grippers *perform their operations, and upon their action depends that important desideratum of press-work, accurate register, or the backing of the pages on the paper and this purpose is so fully effected, that from the many thousands of sheets which have passed through my machine, without the smallest deviation after register was made, I venture to call them, infallible.*"

Napier's machine could print at the rate of 2,000 impressions an hour and, from Hansard's description of it, had merits above the common level of contemporary machines. Its name, in the fashion of the times, was an inspired, although atrocious, pun. It was called the " Nay-Peer."

Steam power had by then been applied to printing but Napier's distinguished customer would have no truck with it. He preferred his machines to be driven by a large, heavy fly-wheel worked by two men. (Three men were employed to turn the cranks, so that each in turn might rest, or sit to receive and lay even the printed sheets as they

Double platen printing machine



A steam-driven Printing press, circa 1850

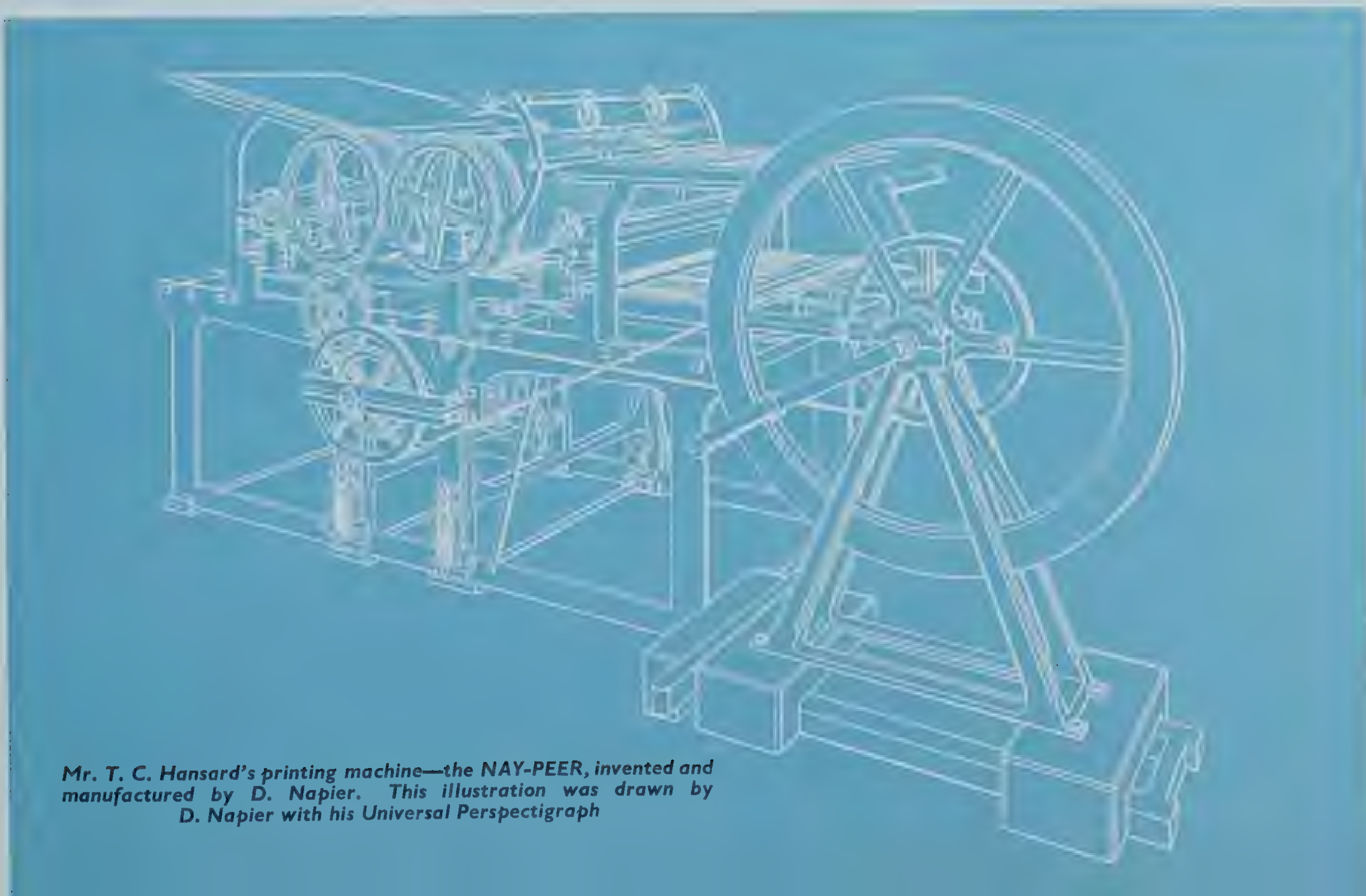
shot from the cylinder. Thus, each man had 20 minutes' relief from crank turning every hour.)

Eight years passed before Hansard overcame his hostility to power and ordered a steam-driven " Nay-Peer." That was in 1832.

The " Nay-Peer " did not, apparently, enjoy wide custom, but other perfecting machines, basically similar, enjoyed a steady sale for many years. Nearly 90 were made between 1836 and 1863, and one was made as late as 1873. They were not widely used for the printing of newspapers, but were bought by "printers of quality"—Waterlow, de la Rue, Bradbury and Evans, Eyre and Spottiswoode, and firms of similar standing. Ingram and Cook, the owners of the *Illustrated London News*, bought one in 1844.

But David Napier made a creditable conquest of the newspaper industry with machines which, having no need to produce work of the highest quality, had few of the mechanical refinements of the perfecting machines. Most of his customers were provincial newspapers, and the machines they bought were the " Desideratum," and the " Double Imperial," which printed twice as fast as the " Desideratum." A limited number of a still bigger machine, the " Large Quadruple," was built; two were bought for printing the *Morning Chronicle*, then the principal rival of *The Times*. Another went to the United States for the New York *Courier Enquirer*.

A Napier printing machine was shown at the Great Exhibition held in London in 1851, and was awarded a Prize Medal.



Mr. T. C. Hansard's printing machine—the NAY-PEER, invented and manufactured by D. Napier. This illustration was drawn by D. Napier with his Universal Perspectigraph

MEN OF NAPIER

A. J. Penn, O.B.E., M.I.Mech.E., F.R.Ae.S.,

CHIEF ENGINEER, AERO GAS TURBINE DIVISION

From the day he joined Napier thirty years ago Mr. Penn has shouldered a steadily growing burden of responsibility and exercised a growing influence over the design and development of Napier aero-engines. He came to the company already endowed with a sound engineering training and several years of practical experience in a motor-car firm's works—solid foundations on which he has since built a distinguished record.

In 1928, the year A. J. Penn joined the company, Napier's first aero-engine, the " Lion " was at the peak of its fame and popularity. It was in use by air forces and airlines of many different countries. It had a long record of racing successes, including a share in both of the two British victories in the post-war Schneider Trophy races. It was being prepared for an attempt on the world's absolute speed record, and for another appearance in a Schneider Trophy race.

To improve its performance it had recently been fitted with a supercharger, then an innovation, and Penn was one of the engineers assigned to the task of developing this device. He found the work exacting but stimulating.

Ultimately, the shadow of obsolescence fell across the " Lion " and Napier called upon the services of a consulting designer, Major F. B. Halford, to draw up plans for a successor. Major Halford strayed from the beaten paths of aero-engineering practice and produced the new and technically revolutionary 16-cylinder, air-cooled, twin-crankshaft " H "-type " Rapier." Because of his experience with the supercharging of the " Lion, " Penn's services were largely employed in the design and development of the supercharger for the " Rapier " and when, later, Halford carried his new formula a stage further with the 24-cylinder, " H "-type " Dagger," he charged Penn with full responsibility for its supercharger and added to this duty a degree of responsibility for performance estimation.

Penn's duties brought him into close personal contact with the designer and his assistants, and he thus acquired an intimate and extensive knowledge of all the basic problems of aero-engine design—a knowledge which was broadened and deepened when Halford advanced to his most ambitious " H " engine, the 3,000 h.p. liquid-cooled, sleeve-valve " H "-type " Sabre." On this engine, Penn was responsible not only for the design and development of the supercharger, but also for the engine's aerodynamic design and performance estimation.

The Sabre became one of World War II's most famous engines, and powered both the Typhoon and Tempest, two outstanding Hawker fighters. At the end of the war, it had still not reached its full development, and but for the jet engine, which by then had emerged from the experimental to the operational state, it would undoubtedly have had a long period of peace-time service. By now, the jet engine was being specified for new fighters and the Sabre, essentially a fighter engine, was dropped.

Pre-occupation with the Sabre had excluded Napier from the war-time gas-turbine development programme, and they had a six-year leeway to make up. They embarked on two ventures—the Nomad, a heavy oil two-stroke piston aero-engine supercharged by a gas-turbine, and the Naiad, a small propeller turbine engine. No aircraft suitable for the Nomad were built, and the Naiad did not, ultimately, win official support.

It was obvious to Penn that bold measures would be required if Napier were to overcome the handicap imposed upon them by their exclusion from early gas-turbine development. He therefore put forward a scheme for an elaborately-equipped research station. The idea was adopted and the station was built and equipped at a cost of a million pounds. Its first dividend was an axial-flow compressor which has been assessed by impartial judges as the best of its class in the world, and which has formed the basis of all the compressors, main and auxiliary, used in and with Napier engines since.

The first engine to have the compressor was the 3,000/3,500 h.p. Eland propeller turbine; the next, the Oryx gas generator. The Eland is now in production, but work on the Oryx stopped when the helicopter for which it was intended was abandoned for lack of official support. This little engine passed its 150-hour Type Test at the first attempt, a distinction held, at that time, by no other British gas-turbine engine.

Napier's latest engine to go into production is the Gazelle free-turbine. This has given its sponsors unqualified satisfaction. Its performance has been exemplary, both on the test bed and in the air, and its prospects could scarcely be brighter.

Penn also provided the design skill for the range of diesel engine turbo-blowers which Napier have been marketing with considerable success for the past ten years or so. He had been experimenting with turbo-driven superchargers, and also with mechanically-driven superchargers for aero-engines from the day he joined the company, and therefore had a large fund of accumulated experience to draw upon.

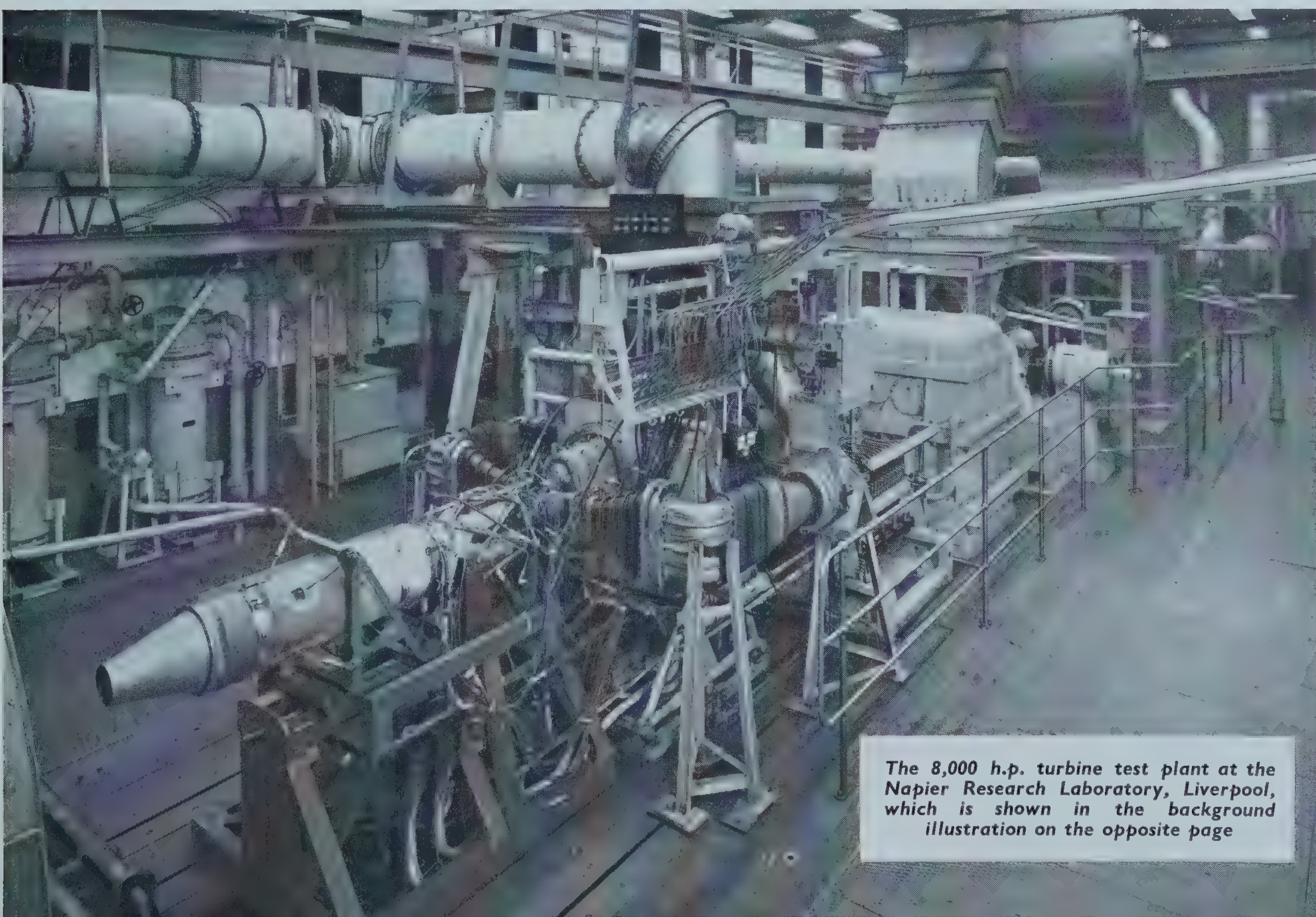
This was not the first " non-aero " enterprise in which Penn had a part to play. Between the two wars, he helped in the design and development of a three-wheeled motor vehicle which, sold to and manufactured by another company, became the famous " Mechanical Horse." At Napiers it was known as the " Mountain Goat."

Looking back over his thirty years with Napier, Penn names the research laboratory as the enterprise which has given him the greatest pleasure and satisfaction. The most testing task he and his department were ever set was that of beating the schedule for raising the power of the Eland from 3,060 e.h.p. to 3,500 e.h.p., so that the Eland-Convair airliner could start its American airworthiness tests with a convincing record of flying hours with the engines at their higher rating.

The translation from piston-engines to gas-turbines was not difficult for an engineer already familiar, from his work on superchargers, with one of the basic problems of gas-turbine engineering—high speed air flow. Nor was age a handicap; at the beginning of the period of transition he had scarcely reached forty.

Success and promotion have come to him not simply because he was a well-trained engineer, but because of his readiness to tackle hard jobs, see them through, and to profit by every lesson he learned. His mind is elastic and vigorous, and he has a marked capacity for imbuing others with his own resolution and zest for work.

In his moments of relaxation, Mr. Penn enjoys nothing more than to listen to accomplished orchestras playing light and classical music, in the concert hall or from recordings. Like most music lovers, he has a fondness for gardens and takes particular pride and pleasure in growing roses.



The 8,000 h.p. turbine test plant at the Napier Research Laboratory, Liverpool, which is shown in the background illustration on the opposite page

Napier's U.S. Subsidiary

Expanding business interests in America led to the formation, last year, of a United States subsidiary, Napier Engines Inc., with headquarters at the Dupont Circle Building in Washington, D.C.

H. Sammons, C.B.E., M.I.Mech.E., F.R.Ae.S., Managing Director of Napiers, is president of the new company. The vice-presidents are J. C. K. Shipp, who is also the English Electric Group representative in the United States, and R. J. Pflum, who recently retired from the United States Navy with the rank of Rear Admiral and is now responsible for Sales.

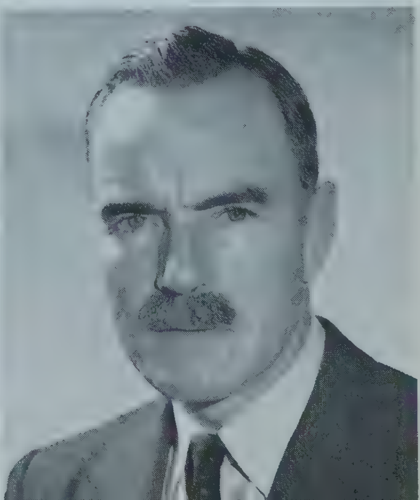
Other members of the Board are Sir Archibald Hope, Bt., O.B.E., D.F.C., B.A., a director of Napier, and R. M. Hilary, M.B.E., T.D., Napier's Commercial Manager.

L. O. Brooks, who was formerly the Napier representative in the United States for the company's diesel activities,

Top left: H. Sammons, C.B.E., M.I.Mech.E., F.R.Ae.S.

Above: R. J. Pflum, Vice-President, Sales

Bottom (left to right): J. C. K. Shipp, Sir Archibald Hope, Bt., O.B.E., D.F.C., B.A., R. M. Hilary, M.B.E., T.D.



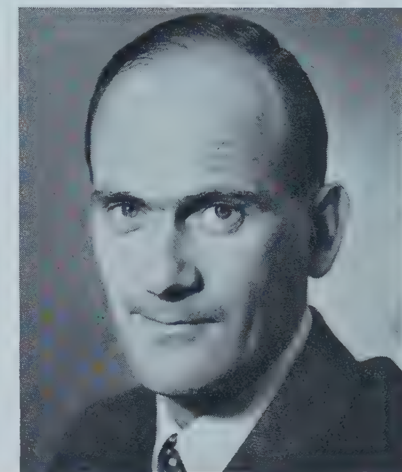
has now been created Manager of the division responsible for all matters relating to diesel engines and turbo-blowers for marine and industrial and rail traction uses. Assisting him is Colin Wilmott, B.A., a former Napier graduate apprentice. Wilmott has his office in New Orleans, and is mainly concerned with the diesel engine requirements of the oil industry.

Manager of the company's aviation division is A. Gualtieri, who is also an ex-Napier graduate apprentice. His assistant is J. Norton, an American whose interests in aviation extend beyond his daily duties inasmuch as he is one of the American Navy's " week-end " flyers.

The principal objects of N.E.I. are, first and foremost, to provide a technical service to Napier's customers in the Western hemisphere. The company is responsible for the sale of Napier products and will deal with the contractual aspects of the overhaul of Napier engines and the provision and distribution of spare parts.

AERO

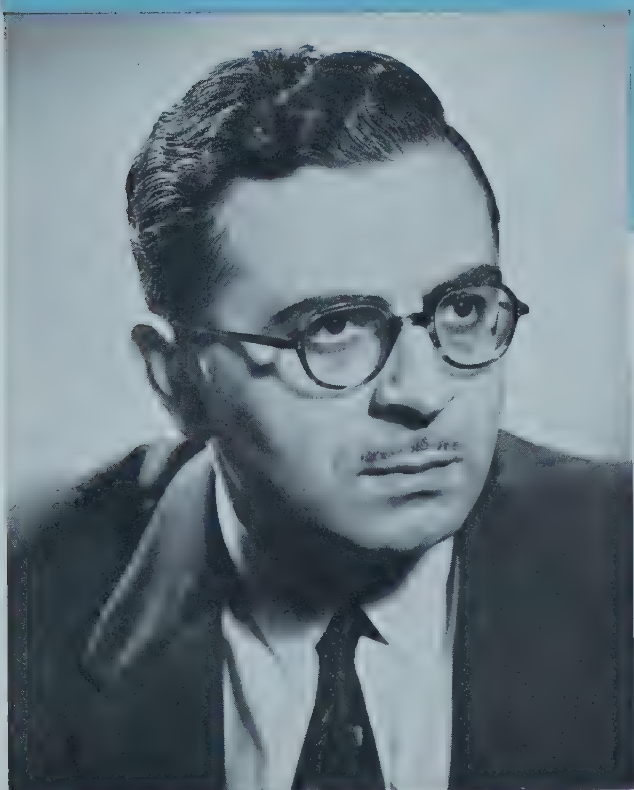
A. Gualtieri



L. O. Brooks

DIESEL

Napier's New Canadian Representative



L. A. Sanson, who has been with Napier for 15 years, has been appointed the company's senior representative in Canada. He is responsible for all aviation and diesel engine activities and in addition will represent the Guided Weapons and Aviation Equipment divisions of the English Electric Company, of which Napier is a member.

Since 1954, he had been Napier's European representative for both Deltic high-speed diesel engines and the Napier range of turbo-blowers. He joined the company in 1943 as a research engineer on the Sabre piston aero-engine, and was later closely concerned with the development of both the Napier Nomad two-stroke aero-engine and the Deltic.

Napier's Canadian office is at 4104 St. Catherine Street, W., Third floor, Montreal, P.Q., Canada.

What the modern Aero-engine type test means

Before an aero-engine can be accepted for civil or military service it must pass the appropriate Type Test. In this country, responsibility for assessing an engine's fitness for civil use rests with the Air Registration Board. The terms of the military test are laid down by the Ministry of Supply. Each defines its own "requirements," and at the end of the test each classifies the engine in accordance with its own formula.

In addition, there is a joint U.S./U.K. Type Test. This was drawn up so that a Certificate of Approval issued by the appropriate authority of the one country could be endorsed and approved by the authority of the other without further test or formality. The Napier Eland took both the U.S./U.K. Type Test and that laid down by the Ministry of Supply.

The greater and most important part of the Type Test consists of 150 hours of running under excessively arduous cyclic conditions—conditions more exacting than any likely to be met in service. Supplementary tests include those designed to prove the engine's ability to fly in severe icing conditions, to "swallow" ice, and to run at speeds in excess of the normal maximum.

The 150 hours of test bed running are made up of 25 stages of six hours, each six-hour stage being fundamentally the same. Minor changes are incorporated in some stages in order to clear such items as low oil pressures, high fuel temperatures and compressor bleeds.

In the schedule for civil engines, the first hour covers: start, acceleration to take-off speed (i.e., full power), 5 minutes at take-off speed, deceleration, and 5-minute periods at ground idling and approach conditions.

Then follows half an hour at maximum continuous power on 15 of the 25 six-hour periods, and half an hour at maximum take-off power on the other 10 six-hour periods. (The two conditions are intermixed.) This is followed by 1½ hours at maximum continuous power.

For the next 2½ hours the engine is run for equal periods at 15 different speeds from ground idling to maximum continuous power, each increase being approximately the same. The object of this test is to discover if, at any speed, the engine suffers from vibration—particularly critical vibration of the compressor and turbine blades and discs.

The final half-hour is made up of six five-minute cycles in each of which the engine is accelerated, holds maximum take-off power for 30 seconds, is decelerated and spends the rest of the five minutes at ground idling speed.

In the case of the Eland, the overspeed test consisted of five minutes at 75 per cent. of maximum take-off power, followed immediately by 15 minutes at 3 per cent. in excess of maximum take-off speed.

In the course of the tests the engine has to make a total of 100 starts. Some are "cold" starts, some "hot," some "false" starts followed by normal starts, and the rest are normal starts.

All the important engine parameters, such as those of speed, power, fuel consumption, jet pipe temperature, oil pressure and temperature are recorded at short regular intervals. For this purpose, the engine is elaborately instrumentated; the readings are used to compile the engine performance ratings and operational limitations.

In the course of the 150-hour Type Test, the engine is run at take-off power for a total of 18¾ hours, and at maximum continuous for 45 hours. It has to complete 300 accelerations and decelerations.

The "Normal Category Approval" issued by the Air Registration Board for the Eland gives the following performance and relevant details applicable to running under International Standard Atmospheric static conditions at sea level:

Maximum Take-off Rating:
3,230 propeller shaft horse-power, 700 lb. thrust } = 3,500 equivalent horse-power
12,500 r.p.m.

Maximum Continuous Power Rating:
2,670 propeller shaft horse-power, 625 lb. thrust } = 2,910 equivalent horse-power
12,000 r.p.m.

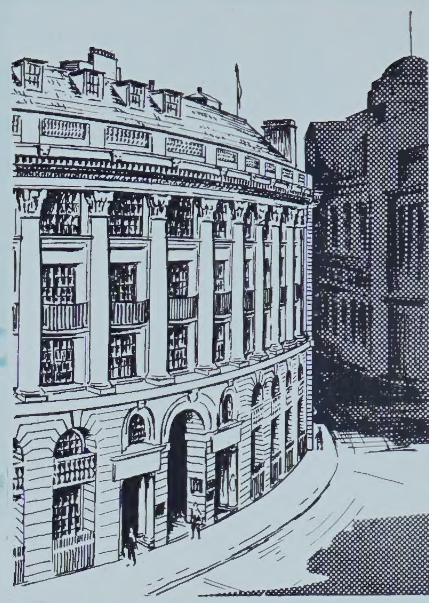
The Type Test applies with equal force to the engine's accessories and, in the case of the propeller turbine engine, to the propeller. Thus, the failure of an accessory might disqualify the engine and demand another test.

Success in an official Type Test does not guarantee the engine against mechanical or other forms of failure in the future, but it does mean that the engine has proved itself capable of meeting a schedule of tests calculated to search out any defect in design and construction that might imperil life.

Few engines pass the test at the first attempt—which is, perhaps, a powerful compliment to its thoroughness.

Eland on the test bed

Agents abroad



The company's agents in Japan, Jardine Matheson, can boast of an antiquity almost as great as Napier. The founders of the business, two Scotsmen, met in Canton in 1818, and formed a partnership with Hollingworth Magniac and a toy-maker named Beale, whose goods were popular among servile Chinese merchants seeking Court favour.

At that time the Honourable East India Company had a monopoly of trade with India and China, and was empowered to punish—even hang—anyone attempting to break it. That was but one hazard the merchant adventurers had to face. There was, in addition, Chinese opposition—often armed; an unhealthy climate, restricted movement, limited resources, piracy at sea, unscrupulous competitors, and a succession of wars in Europe; but the partners, and other British merchants, survived their perils and adversities, and ultimately prospered.

Magniac and Beale retired in 1832, and Jardine and Matheson formed their own company. By then the monopoly of the East India Company had ended, and trade with China began to expand rapidly. Jardine, Matheson & Co., exploiting their position of advantage with enterprise and skill, secured a large and lucrative part of the swelling traffic between China and the rest of the world.

William Jardine retired in 1842 and returned to England, taking with him the distinctly unflattering sobriquet " Iron-headed Old Rat," which was given him by the Cantonese after an incident in which he was hit on the head with bamboos by demonstrators and suffered no harm.

Some years later, relations between the company and the community became close and cordial and were recognised by a charming gesture—the naming of the firm " E-WO," which means " happy harmony."

When Great Britain acquired the island of Hong-Kong in 1842, Jardine Matheson were among the first to set up offices there. Year by year the company's business grew, and soon there were offices over a large area of China, in Japan and Formosa.

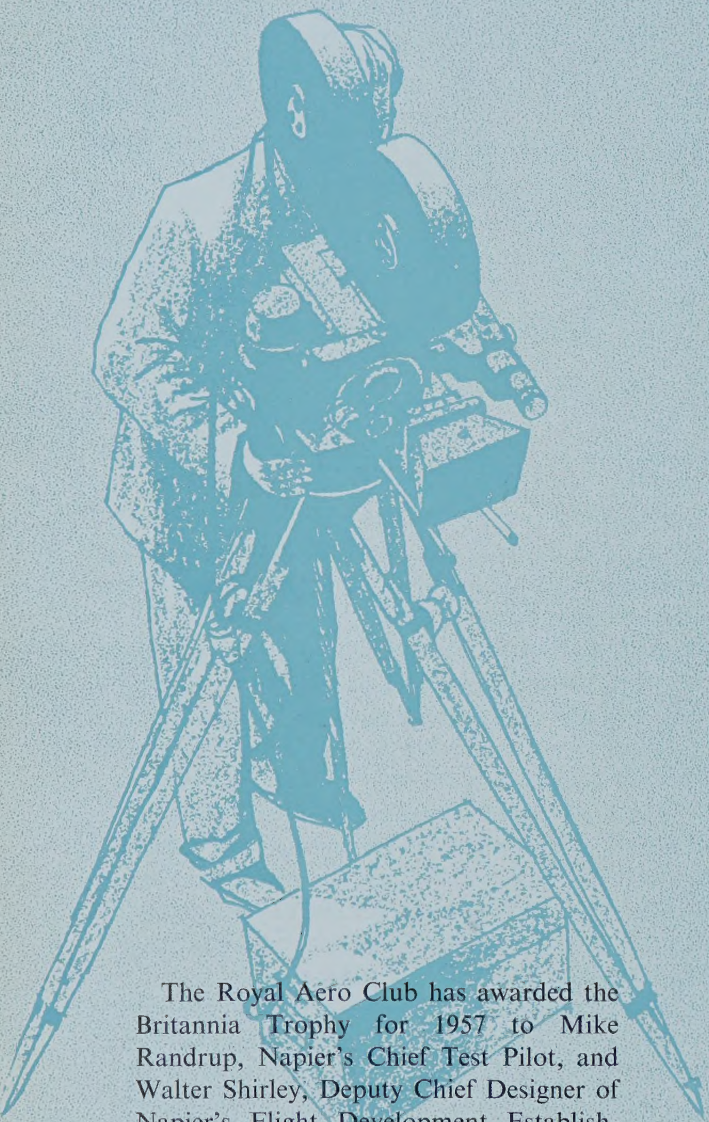
Jardine Matheson played an influential part in bringing railways to those parts of the East where they had trading interests. In this they had to be patient; one project was debated by the Chinese Government for twelve years and the first track to be opened (between Shanghai and Woosung) was quickly closed because of a suicide on the line.

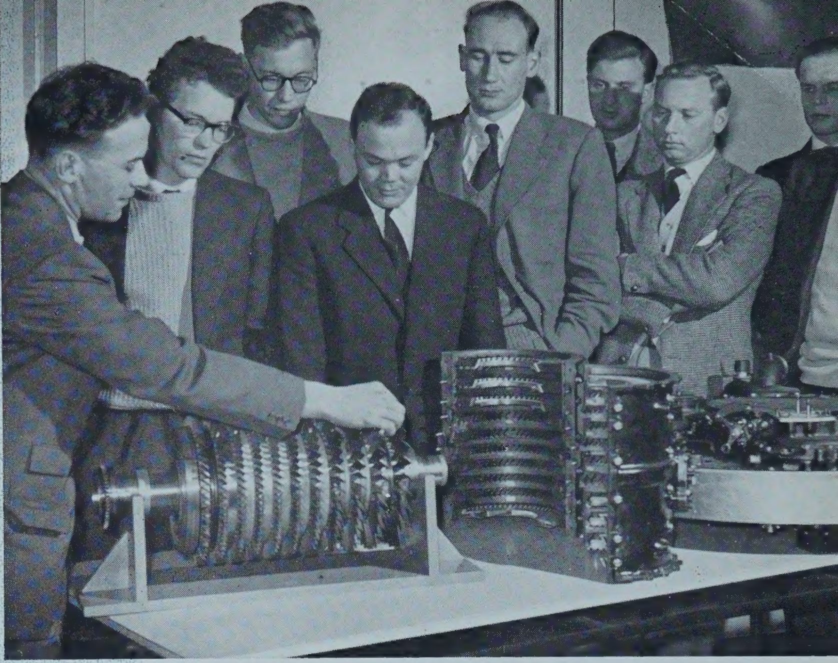
The company brought the first steam merchant ship into Chinese waters, in 1835, and in 1881 formed the Indo-China Steam Navigation Co. It also started insurance companies, built cotton mills, wharves and warehouses, and sponsored other facilities for handling the vast volume of goods entering and leaving Far East ports.

Japan's attack on China in 1932 and, later, the outbreak of war in 1941, had grave repercussions on the company's business in the Far East. In the war in the Pacific the company's ship *Liwo*, hastily armed, sank a Japanese troopship before being herself blown to pieces. The commander was awarded a posthumous V.C.

Jardine Matheson, whose address is 210-212, Fukoku Building, No. 2 2-Chome, Uchisaiwai-Cho, Chiyoda-ku, Tokyo, are Napier's agents for turbo-blowers, diesel engines, and all aviation products.

NAPIER NEWSREEL





The Royal Aero Club has awarded the Britannia Trophy for 1957 to Mike Randrup, Napier's Chief Test Pilot, and Walter Shirley, Deputy Chief Designer of Napier's Flight Development Establishment, for their record-breaking flight in a Scorpion-equipped English Electric Canberra jet bomber last August, when they raised the world altitude record for aeroplanes to 70,310 ft.

Mike Randrup has also been awarded the 1957 Derry and Richards Memorial Medal by the Guild of Air Pilots and Air Navigators for "flying of outstanding value to the advancement of the science of aviation."

Left to right: Mike Randrup, Walter Shirley, and the Scorpion-Canberra with which they made the record

One of two rigs which have been built by the Helicopter Division of Bristol Aircraft Ltd., for developing and testing the engines, transmission and rotor head systems which will be used in the production version of the Bristol 192 helicopter. The 192 is powered by Napier Gazelle free turbines and the first is expected to be flying this summer

Courses of instruction are now being held at Napier's Acton Works for engineering personnel who will be engaged in servicing the Gazelle free-turbine, which has been chosen for the Westland Wessex naval helicopter and the Bristol 192. The photograph shows students receiving instruction on the Gazelle compressor

Mr. Wu Ta Kuan, B.Sc., Chief Designer of the Research Institute, Power Machinery, Peking, China, and a member of a Chinese Trade Mission to Great Britain, with Mr. A. Gauci of Napier's Turbo-Blower Sales Department during his visit to Napier's Acton Works

The redesigned nose of the prototype for the Gazelle-engined Westland " Wessex " naval helicopter


THIS IS NAPIER